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Some French Train Services and Locomotive Performances.

BY

G. F. BURTT, Member, Lewes.

With an abstract of the discussion upon the Paper.

NINETEENTH PAPER
(OF TRANSACTIONS).

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Some French Train Services and Locomotive Performances.

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In presenting this paper before the Institution, the author wishes to emphasise the fact that it has not been written with a view of criticising French practice—as that may be well left to the discussion—but with the idea of bringing to the notice of the meeting the actual practice prevailing on the railways under consideration. To draw comparisons of the methods that prevail in one country with that of another is, in the opinion of the writer, hardly compatible with reason or justice, as the customs and requirements of one nation are frequently so entirely different from that of others.

France is served by six great railway systems, each accommodating a well defined area which their names indicate; the Nord, Est, Midi, Paris Lyon et Méditterranée, Paris a Orleans, and the Etat, which latter serves a district situated between Bordeaux in the west and Dieppe in the north. France is perhaps unique to the extent that being a country largely devoted to agricultural pursuits, it has few really very large towns besides Paris, Lille, Lyon, Marseille, Bordeaux and Nantes, and these are situated many miles apart, and in no instance excepting Bordeaux and Nantes do any two lines serve the same district or even town of any importance from a competitive point of view. Consequently competition is non-existent, and by virtue of that consideration it might at first sight appear disadvantageous to the country. But, bearing in mind the comparatively long distances traversed, the railway accommoda-

tion for ordinary or commercial purposes, both as regards speed and comfort, taken on the whole, probably exceeds that of any railway system on the Continent, taking into consideration that the French as a nation are not travellers in the same sense as the English. Excursions or "trains de plaisir" are run on certain fête days or on special occasions, but recognised fixed day excursion trains are not in vogue as in England. But, however, when the political difficulties of the long proposed Anglo-Franco tunnel scheme have been surmounted and the tunnel becomes "un fait accompli," the English spirit for travelling may become instilled in the French by running through trains from London to Paris, which distance in all probability would not exceed 285 miles and could be easily accomplished in five hours, permitting a person to make the journey from London to Paris, spend several hours at the latter city, and then reach London the same evening.

The trains are divided into four categories, "omnibus," being ordinary stopping trains conveying first, second and third class passengers; "express," stopping at fewer stations; the "rapides," conveying mostly first and second class passengers and only stopping at towns of importance; and the "trains de luxe," composed of vehicles belonging to the "Compagnie Internationale des Wagons Lits et des Grandes Express Europeens," which are confined to the through traffic from Paris and Germany, Italy, Spain, etc. The number of trains run, and especially expresses, is not great, and consequently the number of locomotives per railway is proportionately small. The following figures for the year 1911, taken from "Le Journal des Transports," may be of interest:—

Railway.	Mileage.	No. of Engines.	Miles run.	Miles run per Loco.	No. of Coaches.
Nord ...	2,386	2,160	56,680,742	26,245	5,143
Est ...	3,123	1,727	44,918,121	26,019	3,947
P.O. ...	4,639	1,980	43,346,400	21,890	4,877
P.L.M. ...	5,971	3,424	64,842,833	18,938	6,949
Midi ...	2,471	1,023	22,777,006	21,657	2,648
Etat ...	5,577	2,701	59,263,395	21,940	6,475

One serious drawback in train accommodation is the scarcity of facilities granted to the majority of third class passengers, inasmuch as no "rapides" have third class accommodation excepting on the Etat and the Midi, but in both these instances the speeds are poor.

The author in this paper has confined his remarks to

the systems of the Nord, P.L.M. and the Paris a Orléans, as these three lines have come more under observation. It is first proposed to deal with the Nord, and on that system the very essence of really fast running is to be found, and is undoubtedly not equalled in any country for the number of trains with such high scheduled timings. Their most famous train is the "Nord Express" (No. 179), which is a "train de luxe," being a through train from Paris to Berlin and twice weekly to St. Petersburg. It is booked to leave the Gare du Nord, Paris, at 1.45 p.m., making a non-stop run to St. Quentin, covering the distance of 95.69 miles in 94 minutes, a booked start-to-stop speed of 60.48 miles per hour, thus becoming the longest fastest run in Europe. The writer well remembers making this trip on the footplate of engine No. 2,641, the second of the first two of the four-cylinder de Glehn Atlantic compounds, in February, 1901, after she had come out of the Paris Exhibition of 1900. At that time the train was composed of the Nord Company's stock, and although the load was only about 160 tons—exclusive of the engine—and it had recently been snowing hard and the rails pretty greasy, St. Quentin was reached three minutes before time. The allowed time then was 102 minutes, giving a speed of 56.28 miles per hour, but the actual point to point speed was 57.96 m.p.h.

The next best train is the 7.10 p.m. Paris-Brussels, running non-stop to Busigny, 112.47 miles in 114 minutes, thus giving a point-to-point speed of 59.16 miles per hour. Another very good run is the evening Paris-Lille express, leaving Paris at 5.20 and arriving at Lille at 8.14, the total running time being 166 minutes for the 156 miles, giving a speed of 55.8 miles per hour, with three intermediate stops. Excepting the Nord express the really best trains are ordinary "trains maritime"—"Peninsulaire Express," Fridays only; "Calais-Marseille-Bombay Express," Thursdays only; and the famous "Calais-Mediterranée Express," this latter train running from November 15th to May 15th. The best run between Calais and Paris is the 1.15 p.m. (train No. 6), arriving at 4.40, with a five minutes' stop at Amiens, the total booked running time being 200 minutes, giving an average speed of 54.46 miles per hour, the distance being 184.92 miles. The distance from Calais to Amiens is 104.02 miles and the time allowed is 113 minutes, giving a speed of 55.23 m.p.h., from Amiens to Paris is 80.9 miles, but the running is slightly faster, as 87 minutes is allowed, thus increasing the running

average to 55.74 m.p.h. The Amiens-Paris section of the road being considerably easier than the Calais-Amiens section, the run from Amiens is not by any means equal to the Calais-Amiens running. Between Paris and Calais the best run is the 9.55 a.m. (train No. 5), due at the Gare Maritime, Calais, at 1.10 p.m., but although this train is shown in the public time tables as a non-stop run—and the only non-stop train—it stops at Abbeville three minutes for locomotive purposes, and deducting this three minutes' stop, the total running time is 192 minutes, giving an average speed of 57.78 miles per hour, and allowing for the reduced speed slacks at Creil, Amiens, and the Boulogne curve, it must be considered a very smart piece of running. The distance from Paris to Abbeville, 108.73 miles, is booked to be covered in 113 minutes, this working out at a speed of 57.72 m.p.h., and from Abbeville to Calais, 76.19 miles, the time allowed is 79 minutes, giving a speed of 57.84 miles per hour. Although the Paris-Calais section is not on the whole severe, there is a long pull for about 12 miles on leaving Paris and a stiff section between Boulogne and Calais. The writer, during the latter part of last year and early this year, made several footplate trips on the engines hauling these trains, and the following log taken last May is evidence of the very fine work that is accomplished on the Nord. On the occasion referred to, the train was the 9.55 a.m., made up as follows:—6-wheeled P.L.M. brake van, P.L.M. bogie, first and sleeping car, P.L.M. bogie, first and second compo., restaurant car, four Nord bogie firsts, two Nord bogie seconds, one Nord bogie first and sleeping car brake, and one Nord 4-wheeled truck with four boxes of through registered luggage, the total weight to be hauled, exclusive of engine, but inclusive of 342 passengers and luggage, being 391.7 tons. The train was hauled by one of the twenty new 4-cylinder de Glehn compound Pacifics, No. 31,154, designed by M. Asselin, l'Ingenieur en Chef du Materiel et de la Traction, and built by the Societe Alsacienne, Belfort, at the latter end of 1912. These engines are now superseding the 4-cylinder compound Atlantics which did such good work on these fast trains, although the latter are being fitted with superheaters as they go through the shops. Leaving Paris at 9.56¼, 1¼ minutes late, the train got away at a moderate speed and working as a high pressure engine for two miles out, St. Denis was passed—3.72 miles in 6¼ minutes, this being a speed of 35.4 miles per hour, and then commenced the long pull up the Survilliers bank of 12 miles, at 1 in 200,

at an even speed of 49 m.p.h. with the regulator three parts open and an admission of 50 and 60 per cent. in the high pressure and low pressure cylinders respectively. Going up the bank the steam pressure showed no signs of a fall, the summit was reached 16.77 miles from Paris in 21 min. 45 secs., and Orry-la-Ville, five miles from the summit (1 in 200) down, was passed at 10.20 at a speed of 77.5 m.p.h. Chantilly was passed, going at 69 m.p.h., at 10.25, and Creil at 10.32, speed through the station being reduced to 50 m.p.h. for the St. Quentin Junction. Getting clear of Creil, St. Just was passed at 10.52, having accomplished between those stations a distance of 18.1 miles in 20 minutes at an average speed of 54.3 m.p.h. up the bank of 1 in 500. Soon after passing St. Just, a permanent way slack for bridge repair necessitated the speed being reduced to 18 m.p.h., but clear of that the speed was soon increased and Breteuil, 58.78 miles from Paris was passed at 11.0¾ at 76 m.p.h.

Running down the 1 in 133 bank, La Faloise, 5.77 miles from Breteuil, was passed at 11.6, the speed through the station being 74.5 m.p.h., the 4.28 miles between here and Ailly-sur-Noye was done in 3¾ minutes at 68.4 m.p.h., and maintaining a speed from 68 to 70, with the regulator three parts open, Amiens was passed at 11.20½ at 30 m.p.h., although the regulations limit the speed to 25 m.p.h. through the station. The run from Paris, 80.9 miles, was done in 84 min. 15 secs., this being a point-to-point speed of 57.60 m.p.h. Immediately through Amiens and Amiens St. Roch speed was increased and Picquigny, 8.76 miles, was passed in 9¾ minutes at an average speed of 52 m.p.h., but the engine having fairly got the train in hand the speed was increasing and Picquigny was passed at a speed of 71.5 m.p.h., and a continuous speed, fluctuating between 65 and 70, was maintained right up to Pont Remy, which was passed at 66¾ m.p.h. at 11.43, 13.67 miles in 12¾ minutes. Immediately after running through the station a permanent way slack reduced the running to 50 m.p.h. A gentle run into Abbeville, stopping at the crane for water and examinations at 11.49, completed the 108.73 miles in 112¾ minutes, 15 seconds under the booked time, this being an average running speed of 57.72 miles per hour. Amiens to Abbeville and on to Etaples being a racing ground with several dead level and falling gradients, averaging 1 in 100, and the momentum of heavy trains pushing on behind, high speeds are always attainable. Leaving Abbeville at 11.52 speed was soon attained, Pont-le-Grand was passed at

41.9 m.p.h. at 12.0, Rue at 64.80 m.p.h. at 12.9¼, and this speed was maintained up to St. Josse, which was passed at 12.21¾, but between that station and Etaples the speed fell to 49.68 m.p.h., but 59 was reached on passing Etaples Station at 12.25½. Up the Dannes-Camiers bank, of 1 in 143, to Neufchatel the speed fell to 43.49 m.p.h., and the station, 1¼ miles over the summit, was passed at 12.35. And then another smart sprint followed, Hesdignuel being passed at 12.37¾, going at 67.20 m.p.h., increasing to 77. When approaching the junction for Boulogne Ville and the sharp curve—which it is the prevailing practice to negotiate at a speed the advisability of which a British Board of Trade inspector would question—speed was immediately reduced to 50 miles per hour. Directly round the curve, which is on the viaduct crossing the river Liane and at the mouth of the Hauteville tunnel, the 1 in 200 bank is commenced. Boulogne Tintillieries was passed at 12.44 at a speed of 60 m.p.h., but the bank soon began to make itself felt, so much so that at the summit the speed had fallen to 32. Wimille-Wimereux was passed at 12.48¾ at 36.6 m.p.h. Marquise-Rinxent, at a distance of 6¾ miles (the grades between fluctuating up and down 1 in 125) was passed at 12.55½, and then followed a 1 in 125 pull of 5 miles to Caffiers, maintaining a continuous speed of 45 m.p.h. Over the top is a clear run down to Calais on a 1 in 125 fall for a distance of 6.83 miles, and down this bank some very high speeds are often attained. Frethun was passed at 1.8¼ at a speed of 77¾ m.p.h., Les Fontinettes at 1.10¼, 65 m.p.h., and then with cautious running at 40 m.p.h. through Calais Ville at 1.12, Calais Maritime was reached at 1.16, six minutes late, having lost five minutes on the section from Abbeville, the average booked speed being reduced from 57.84 to 54.42 m.p.h. Now why the engine should have lost five minutes on the Calais-Abbeville section is difficult to see. However, it was lost on the inclines between Boulogne and Marquise-Rinxent, as the speeds were well below 40, and in commencing the Caffiers bank was only 57 m.p.h., it usually being nearer 70 at this spot. It must be borne in mind that the load was 391.7 tons, which must be considered a moderately heavy train, but at the same time should not be considered as over-taxing a powerful 4-cylinder 4-6-2 engine. Another fact that should not be overlooked is the great caution that it is necessary to exercise in running into stations and the very slow application of the air brake. The questionable practice of allowing the public to parade across the running lines

—in spite of the adoption of subways—necessitates these cautious approaches, and on this occasion, owing to a second train following, the train pulled up at the extreme end of the Maritime Station, and quite thirty seconds was taken in doing this from the time of entering the station. Before concluding with the Nord system, the following timing of the 2.50 p.m. Calais-Paris (train No. 18), is worth recording as a good average run. It is timed to leave Calais Gare Maritime at 2.50, stopping at Calais Ville for two minutes and then running non-stop to Amiens, the distance between the two latter stations being 102.41 miles, booked to be run in 118 minutes at a point-to-point speed of 51.96 miles per hour. This was done at a speed of 55.32 m.p.h. From Amiens to Paris the distance is 80.9 miles, scheduled to be run in 91 minutes, the point-to-point speed being 53.27 m.p.h., but the actual speed on the occasion when the writer made this run was 54.18 m.p.h. The booked running time throughout is 3 hours 33 minutes, but the run was accomplished in 3 hours 28½ minutes. This run under notice having been done on Whit Sunday of this year the load was lighter than would have been the case if done on an ordinary day. The train was made up as follows:—Engine No. 3,1156 (one of the Pacifics already referred to), 4-wheels truck with the boxes of registered luggage from London, which are unshipped at Calais and work through to Paris, one Nord first class sleeper, one Nord second, two Nord firsts, one P.L.M. first, one Nord first and second compo., one P.L.M. first and second compo., and two Nord six-wheeled brakes, making a load exclusive of the engine, but inclusive of passengers and luggage, of 320 tons. Calais Maritime was left sharp on time at 2.50 p.m., but two minutes was dropped in getting to the town station, leaving at 2.58, two minutes late, and for a short distance working as a 4-cylinder high pressure engine. Notching up and compounding, after getting well in hand, the "mechanicien," intent on being up to time at Amiens and of showing what the Pacifics would do, the train passed through Les Fontinettes—the junction for Lille—and over points and diamond crossings at a speed such that the oscillations of the trailing end of the engine had a decided tendency to cause a certain amount of apprehension as to what might happen if certain events should take a turn of an unpleasant nature. The bank of 1 in 125 to Caffiers commences 2.79 miles from Calais Ville and the summit was reached in 15 minutes at a point-to-point speed of 38.76 m.p.h., and then down on a similar grade and several short

sections undulating at the same incline to Boulogne Tintilleries, 22.49 miles from the start, which was passed at 3.27, the running average from the summit at Caffiers being 47.94 m.p.h. The curve at Boulogne was negotiated at 43 m.p.h., and then clear of the junction for Boulogne Ville, on practically a level stretch of 4¼ miles followed by an ascending incline of 1 in 133.3 to 1 in 142.8 for a length of 4.97 miles and then down, the grade ranging from 1 in 133.3 to 1 in 500. Etaples was passed at 3.45½, this section giving a running average of 59.56 m.p.h., the speed up the bank not falling below 45 miles. From Etaples to Abbeville the distance is 31.63 miles—the ruling grade, which is on the rise, being 1 in 500 with several stretches of 1 in 1,000 and level—this was run off in 32¼ minutes at an average speed of 58.80 m.p.h. On this section 73 m.p.h. was run for about two miles. With a running speed averaging 55.44 m.p.h. between Abbeville and Longpré and Longpré and Amiens at 52.20 m.p.h., with a 12 m.p.h. slack outside Amiens, the train pulled up at Amiens at 4.49, five minutes ahead of time, having run from Abbeville, 27.83 miles, in 31¼ minutes. Stopping at Amiens the booked five minutes for water, examinations, etc., a start was made punctually at 4.54½. Commencing with a level stretch of 2.75 miles to Longeau follows the bank of 23.75 miles, ranging from 1 in 333.3 to 1 in 250 to Cannes, run at a uniform speed of 50 m.p.h., and then a falling grade for 5.13 miles to St. Just, which was passed at 5.28½, brought up the running average to a point-to-point speed of 55.8 m.p.h. From St. Just to Clermont, passed at 5.37½, a distance of 8.94 miles on the falling grade of 1 in 250 was covered at a speed averaging 57.96 m.p.h., Clermont to Creil, 9.25 miles, at 1 in 500 down, was run at 55.5 m.p.h., with a reduced speed check through the station at 5.47½, and Chantilly was passed at 5.54. Continuing at a running average of 51 m.p.h. up to La Chapelle, where a long check to six miles per hour was encountered, a cautious run into the Gare du Nord was made at 6.24 p.m., the total running time from Calais Maritime being 3 hours 26½ minutes for the 184.92 miles. Mention should be made of the 12 noon Paris-Calais express, which is a fine train, of which is appended a log as far as Calais Ville.

CHEMIN DE FER PARIS A ORLÉANS.

In this section of the paper the author has confined his observations to the train services of the Paris-Bordeaux

section of the Chemin de fer Paris a Orléans. Between Paris and Bordeaux there is an exceptionally good service, there being as many as nine trains during the summer, of which four are "express," two "rapide," one "omnibus," and two "trains de luxe," namely, the "Sud Express" and the "Pyrénées-Cote d'Argent Express." Between Bordeaux and Paris there is a service of ten trains, of which six are "expresses," one "rapide," one "omnibus," and the corresponding return "trains de luxe." The two latter trains are composed of stock belonging to the Compagnie Internationale des Wagons Lits, etc., and are the cheapest trains de luxe in France, the supplementary fare being lower than that of any other train belonging to the C.I. des W.L., etc. The "rapides" not belonging to the latter company are consequently not rated as "trains de luxe," although as a matter of fact it would probably be no exaggeration to say that they are the most luxuriously fitted trains in Europe, certainly in France, offering as they do the acme of comfort and luxury to travellers. These trains are exclusively composed of first class bogie carriages, a saloon car, and a restaurant car. The saloon car, which is of special design, is replete with sofas and armchairs and exceptionally large windows, there is also a library, writing materials, papers, magazines, etc., a special feature being a newsboard where the latest wires are put up at the principal stopping places. Women attendants also accompany these trains. If the booked average speeds of the P.O. do not equal those prevailing on the Nord, they more than make up for this deficiency in the appointment of their trains. All long distance trains start from and terminate at the Gare Quai d'Orsay, the comparatively new Paris terminus, which is 3.72 miles further into the city than the old Gare situated on the Quai d'Austerlitz. Between these stations all trains are electrically hauled, the steam engines coming on and off at the latter and not working in any circumstances into the station on the Quai d'Orsay. This station is unique in as much as when the line was continued from the Quai d'Austerlitz it was made almost entirely in tunnel, the platforms being some distance underground, the waiting-rooms and booking offices, etc., being on the street level. The platforms are built to the same height as the footboards of the coaches, this being the only instance to the knowledge of the author where the platforms are built on the English system, excepting the Paris Metropolitan. All the Paris-Bordeaux and Bordeaux-Paris rapides" make four intermediate stops, namely, Orleans,

75.18 miles out; Tours, 71.46 miles from Orleans; Poitiers, 62.76 further on; Angoulême, 69.60 miles; and thence to Bordeaux, Gare St. Jean, 83.88 miles. This latter section is the longest non-stop run on the P.O. The fastest train down is the "Sud Express de Luxe," which is the day through train to Spain, the composition being two bogie brake vans, one restaurant car and four saloons. From Bordeaux this train is taken on by the engines of the Chemin de fer du Midi to the Franco-Spanish frontier at Irun. This train is booked to leave the Quai d'Orsay at 12.16 p.m. and the Gare Austerlitz at 12.26, and is due at Bordeaux, Gare St. Jean, 366.6 miles from Paris, at 7.9 p.m., having a booked average speed, deducting stoppages, of 56.72 miles per hour throughout. The total time on the journey from the Austerlitz Station is 6 hours 43 minutes, the total running time being 6 hours 24 minutes. The best running with all up and likewise down trains is on the section between Orleans and Tours, in the case of this train just mentioned the booked point-to-point speed is 59.52 m.p.h., but although that is a high point-to-point speed the load is not excessive, not exceeding 260 tons, and the gradient falling all the way from 1 in 1,000 to 1 in 500. The next best train is the 9.46 a.m. from Paris, which is due at Bordeaux at 5.7 p.m., with a booked point-to-point speed from the Austerlitz Station of 53.58 m.p.h., the total running time being 6 hours 46 minutes. Between Orleans and Tours the booked point-to-point speed is as high as 56.4 m.p.h. The down 9.0 p.m. "Pyrénées Cote d'Argent Express," due at Bordeaux at 4.37 a.m., has a booked average speed of 52.92 m.p.h. The night trains have a lower booked timing, 56.41 m.p.h. being the Orleans-Tours running average. These three represent the best of the down trains, and on the up service the most notable are the return "Sud Express," which leaves the Gare St. Jean at 2.3 p.m. and due to arrive at Paris Austerlitz at 8.54 p.m., the total running time being 6 hours 13 minutes, giving an average speed throughout of 56.84 m.p.h. The best running section is from Tours to Orleans, which is scheduled at 58.56 m.p.h. in spite of it being on a rising gradient of 1 in 500 for a distance of 62.76 miles. The 11.4 a.m., the only up ordinary "rapide," due at Paris Austerlitz at 6.11 p.m., is booked at 54.31 m.p.h., but is a much heavier train than the "Sud Express." The highest average running is also on the Tours-Orleans section, the speed being 56.4 m.p.h. The remaining up train of notice is the return "Cote d'Argent," leaving at 1.22 a.m. and

due at Paris Austerlitz at 9.31 a.m., the total time of this train throughout to the Quai d'Orsay being 8 hours 5 minutes, the total running time 7 hours 43 minutes, and the average booked speed 47.16 m.p.h. The stations at Orleans and Tours being terminals, main line trains do not run into these stations, but set down and pick up passengers at Orleans Les Aubrais, $1\frac{1}{4}$ miles outside the city, and for Tours at the Gare St. Pierre des Corps, $1\frac{7}{8}$ miles from the terminal station. The main stations are connected by spur lines, both up and down passengers being conveyed by a local service. Having reviewed the speeds of the principal of the Bordeaux trains and taking into consideration the train loads, which are not over heavy and in some cases quite moderate, the comparatively easy gradients, and the great locomotive power at the disposal of the traffic department, the question might well be asked why some of the train timings are not accelerated. As the timings now stand, the exceptionally powerful Pacific engines, all Belfort productions of 1911 and 1912, with their enormous reserve of power, have a fairly easy time of it. The policy of the big engine is fully justified in that the average speeds on the up grades are only slightly below those on the down, thus entirely dispensing with the fast down hill running and making the speeds throughout more uniform. The P.O. was the first company in France to adopt the 4-6-2 type. These fine engines make a very striking contrast to the blue lagged "Yankees" and the old stagers with their low pitched all brass cased boilers, two large domes and connecting steam pipe, that are passed on the road ambling along with their "omnibus" trains. The Paris-Bordeaux line is not really a difficult one, the steepest gradient being 1 in 125 for a length of $6\frac{1}{4}$ miles, and probably nowhere in France will such long sections of practically a uniform gradient be found. The gradients may roughly be summarised as follows:—Starting from Paris Austerlitz the line rises to Juvisy, $11\frac{3}{4}$ miles, at 1 in 1,000, thence on to Etampes there is a 23 mile bank of 1 in 400, from Etampes commences the $6\frac{1}{4}$ mile pull of 1 in 125, this point being the summit between Paris and Bordeaux. Then down through Orleans, the famous French flying grounds, the valley of the Loire is entered and on to Tours, a distance of 105 miles, the gradients fluctuate from 1 in 1,000 to 1 in 500. From Tours to Villperdue there is a rise of $13\frac{3}{8}$ miles at 1 in 200 and then falls at the same grade for 15 miles, rising again from 1 in 500 to 1 in 1,000 for a distance of about 34 miles to Poitiers. From here on to

Ruffec, 40½ miles, the line steadily rises at 1 in 200 to 1 in 250 and then falls for 29 miles to Angoulême at 1 in 200. From Angoulême there is a 1 in 285 pull up for 13¾ miles, falling again for 21¾ miles at 1 in 200, followed by long easy falls of 1 in 200 to 1 in 1,000 right into Bordeaux, which is slightly below the level of Paris. Before concluding with the Paris-Orleans line the following account of a run with the 9.46 a.m. rapide, in which the writer took part, may be of interest:—Starting from the Quai d'Orsay right on time the train was made up as follows:—Bogie brake van, bogie restaurant car, bogie saloon, and two bogie firsts, all for Bordeaux and beyond, and two bogie firsts and a bogie brake van for St. Nazaire, which latter portion is taken off at Tours. Six minutes is allowed the double bogie electric engines to run the 3.72 miles to the Gare d'Austerlitz. Here the electric engine comes off and is replaced by a 4-cylinder superheater 4-6-2 type, No. 3,561, and the load supplemented by a four wheels mail van and a four wheels brake van, totalling the respectable load, inclusive of passengers and luggage but exclusive of engine, of 370 tons. Getting away at 9.58½, two and a half minutes to the bad, the run to Bretigny, 19.26 miles, was done in 26 minutes, at an average speed of 44.4 m.p.h., from here the engine began to play with the train, so much so that the next 15½ miles to Etampes was passed at 10.40 at a point-to-point speed of 60.6 m.p.h. From Etampes starts the 6¼ miles pull of 1 in 125, which naturally reduces the running, but not sufficiently to necessitate a higher speed than 63 m.p.h. down the bank. The pull up was done in fine style in spite of greasy rails and a driving rain the whole distance to Bordeaux, a good head of steam was kept and a high degree of superheat. Passing the summit a good run down into Orleans Les Aubrais at an average speed of 58.02 m.p.h. followed, arriving at 11.21¾, ¼ minute before time, the total gain being 2¾ minutes. Orleans was left at 11.27¼, 1¼ minutes late. Blois, which is 36.66 miles further, was passed at 12.6¼, the average running being 56.4 m.p.h. The next 34.8 miles on to Tours St. Pierre des Corps was done in 33¾ minutes at an average speed of 61.8 m.p.h., which, although on a falling grade, was a very fine piece of running. The train pulled up at 12.40, two minutes ahead of time, but 3¼ minutes under schedule timing. At Tours engines are changed and the St. Nazaire portion taken off, thus reducing the load to 295 tons, still perhaps a moderate load for an ordinary engine, but these Pacifics are underloaded with these trains. No. 3,561, a

sister engine to the previous, got away with the train at 12.49¾, being late by ¾ minute. There is an easy pull up to Poitiers, 62.76 miles from Tours, which was reached at 1.59¼, now being 4¾ minutes ahead of time, making a gain of 5½ minutes, the running average being 54.18 m.p.h. At Poitiers time was outstayed by 1¾ minutes, but getting away at 2.10¾, the run of 69.6 miles to Angoulême was done at 54.72 m.p.h., the highest speed recorded on this section being 67 m.p.h., and the station being reached right on time at 3.23, again picking up time. Angoulême was left at 3.24, one minute late, making a bad start and slipping badly owing to the pouring rain, but getting through the tunnel the engine recovered and the run to Bordeaux of 83.88 miles commenced. Ninety-four minutes is allowed for the long run down, but owing to a 6 miles per hour check for a bridge repair and a long check over the Garronne viaduct the train pulled up outside the station at 5.7½, stopped dead for five seconds and then at a walking pace pulled up to the extreme south end of the station at 5.8½, 1½ minutes late on a 366.6 miles journey. The running average from Angoulême to Bordeaux, including the checks and stop, was 53.22 m.p.h. On the following day a run was made with the 11.4 a.m. up "rapide," the composition of the train being as follows:—Bogie brake van, three bogie firsts, bogie saloon, restaurant car, four wheels mail van, and a bogie brake, making a load, including passengers and luggage, of approximately 304 tons. The train was hauled by a 1912 Belfort 4-6-2, No. 3,553, leaving the Gare St. Jean at 11.10, six minutes late, the run of 32.93 miles to Coutras was done at 54.84 m.p.h., the station being passed at 11.46. On passing Le Moulin Chatenier at 12.12½ the speed was checked to 20 m.p.h., but getting clear of the check the speed was soon accelerated, and running at an average of 55.56, Angoulême, 50.9 miles from Coutras, was reached only three minutes behind time, arriving at 12.41, having picked up three minutes in spite of the check. The booked stay of four minutes was exceeded by a minute, and getting away at 12.46, four minutes late, a fine run to Poitiers was made with the result that the train arrived right on time at 2.1 p.m., thus making up the four minutes which was to the bad on leaving Angoulême, having done the run of 69.6 miles at a point-to-point speed of 55.68 m.p.h. The traffic department being again responsible, a further delay of 4¼ minutes occurred, with the result that a start was not made till 2.10¼. To Chatellerault from Poitiers it is a run of 21.12 miles, the grade falling at 1 in

1,000, the former station being passed at 2.33, at an average running of 55.68, but including several spurts of 68 miles per hour. The next 41.64 miles to Tours was done at a speed of 56.76 m.p.h., arriving at 3.17, one minute behind time, but having picked up $3\frac{1}{4}$ minutes. At Tours engines are changed, but one of the same type takes the train into Paris. Although due to leave at 3.24, for some reason not apparent, the engine furiously blowing off meanwhile, it was 3.30$\frac{1}{4}$ before a move was made. However, soon getting into a good swing the run down the bank to Amboise, 14.9 miles, was accomplished at 55 m.p.h.; Blois, 19.88 miles, being passed at 4.6$\frac{3}{4}$ at 58.86 m.p.h.; and at an average speed of 55.32, Orleans, 36.67 miles, was reached at 4.46$\frac{1}{2}$, having gained 15 seconds. Starting at 4.52$\frac{1}{2}$, $7\frac{1}{2}$ minutes late, rising gently to Toury, 20.5 miles, and passing it at 5.15$\frac{1}{2}$ the mean speed was 53.46. From here to Monneville, which is 11.18 miles, the line ascends until the summit is reached, and then a six and a quarter mile bank of 1 in 125 follows to Etampes, the point-to-point speed from Toury being 62.4 m.p.h., of which 31$\frac{5}{8}$ miles was ascending. Bretigny, 15.53 miles on, was cleared at 5.50$\frac{3}{4}$, going at 57.36 m.p.h. From here the line descends right into Paris for a distance of 19.62 miles. A mean speed of 49.14 m.p.h. was attained, and with a long slack the Gare d'Austerlitz was reached at 6.14$\frac{3}{4}$, $7\frac{1}{4}$ minutes late, after gaining 15 seconds. The booked stop is three minutes, but $4\frac{1}{4}$ was taken, two electric motors replace the steam engine from there to the Quai d'Orsay, arriving at 6.26$\frac{1}{2}$, thus being $10\frac{1}{2}$ minutes late. From the locomotive point of view the run was brilliant, but at the same time the engines were masters of their loading. From Tours, No. 3,557 was not steaming at times altogether to the driver's liking, neither did she superheat to full advantage. Between Blois and Orleans the pyrometer stood at 552° and then gradually fell to 530°, but improving from Orleans 581° was attained, gradually falling to 302° and then regaining up to 480° into Paris.

CHEMINS DE FER DE PARIS A LYON ET A LA MÉDITERRANÉE.

The third section of this paper is confined exclusively to the winter train services of the Paris-Marseille portion of the Riviera Rapides. As is well known, all roads lead to the famous French Riviera during the months of Novem-

ber to April ; consequently the best trains between Paris and Marseille are confined to the period mentioned. From Paris to Marseille and the coastal resorts terminating at Vintmiglia—which latter town is just across the Franco-Italian frontier—there are nine up and down trains each way ; on the down service two are 1st, 2nd, 3rd class expresses, one 1st, 2nd and 3rd class rapide, two 1st and 2nd class rapides, three 1st rapides, and one " de luxe." On the up there are four 1st, 2nd, 3rd class expresses, three 1st rapides, one " de luxe," and one 1st and 2nd class express, but starting from Marseille there is an extra 1st and 1st, 2nd express. To the credit of the P.L.M. stand three important facts : It has the largest mileage of any line in France, namely, 5,971 miles ; it runs the fastest long-distance train in Europe ; and its best trains carry sufficient passengers to enable it to run a distance of 536 miles—Paris to Marseille—without picking up or setting down passengers, and this latter fact also applies to the goods services from Marseille, that the enormous amount of merchandise from the port is sufficient to run through trains without picking up en route. The best down train is the famous " Cote d' Azur " rapide, which was introduced for the first time in November, 1904, and runs every day—Sundays included—from November 10 until May 15, the accommodation at present being limited to 186 passengers. Previous to the introduction of this train it was imposible for passengers to make the journey from Paris to the Riviera in a day, the express from Paris not proceeding beyond Marseille, it being considered impracticable to do so as it would have meant a very late departure and a consequently late arrival. However, the continual enormous increase of visitors to the South rendered it imperative that some radical improvements be introduced.

This, then, led to the introduction of the 4-cylinder 4-4-0 compounds, subsequently to be superseded in 1905 by the 4-cylinder " Atlantics," then the 4-cylinder 4-6-0 class, and then in 1909 by the huge 4-cylinder " Pacifics," which are the largest and most powerful in France ; this latter type being permissible, due to the carefully maintained permanent way, the rails, which are flat-footed and weighing 97 lb. to the yard, are of the extreme length of 52.93 ft. The gradients may be generally summarised as follows : From Paris to Villeneuve-St.-Georges—9.32 miles—it is almost level ; thence on to Lieusaint-Moissy—9.32 miles—there is a rise of 1 in 200, and then falls at the same grade for $8\frac{3}{4}$ miles to Melun ; from Melun to Montereau—$21\frac{3}{4}$ miles—

there is a similar grade with a gable half way ; thence on to Laroche—47.85 miles—at a rise of about 1 in 500. From Laroche is experienced the most difficult section of the main line, this being a continuous pull to Blaisy Bas, a distance of 82.02 miles, the line rising 1,044 feet above Laroche. This section, although not on the whole, may be considered severe, as the gradients are long, averaging 1 in 200 to 1 in 500, but ending with a stiff section of 1 in 125 for a length of 15 miles. From the summit down to Dijon is 16.47 miles, of which there is a fall for 12½ miles at 1 in 125, the remaining portion being at 1 in 250. From Dijon to Tournus—58 miles—the whole distance, with the exception of very short sections, falls at 1 in 500 to 1 in 1,000, and thence on to Lyon (Perrache)—64 miles—undulating at 1 in 200. At Lyon the valley of the Rhone is entered and thence for 157 miles to Tarascon is a continuous fall, mostly at 1 in 1,000, and thence undulating at 1 in 500 to 1 in 1,000 for just on 120 miles to Marseille. Reverting back to the "Cote d' Azur," when this train first ran it was composed of three large coaches and a restaurant car and was limited to about 120 passengers. Last winter—1912-13—the train was made up with two restaurant cars, three bogie firsts, and two composite firsts classified as "lits-salon," which have, beside the ordinary first class compartments, two special compartments—at a small extra charge—fitted with couches and easy chairs for the benefit of invalids, etc. This fine train, which is, of course, built on the corridor system, is fitted with all the most modern improvements, such as steam heating, electric light, hot and cold water in the lavatories, and carries women attendants. Owing to the great demand for seats on the "Cote d' Azur" it is necessary to book seats beforehand, which are numbered, and in the height of the season is is no uncommon occurrence for the greater portion of the train to be booked a couple of weeks ahead. This train and the "Calais Mediterranee" only take passengers for Marseille and beyond. With this train, which also applies to the other Riviera expresses, the fast running is confined to the Paris-Marseille section ; beyond Marseille, so far as speed is concerned, the running does not call for comment, as the trains stop at all the principal resorts, and the gradients severely undulate. Booked to leave Paris at 9 a.m., six stops are made before arriving at Marseille at 7.25 p.m., the total time on the journey being 10hr. 25min., and the total running time 9hr. 50min., the average speed, exclusive of the stops, being 54.48 miles per hour. As French rail-

way engineers do not favour, as a rule, long journeys without inspection, stoppages sometimes as long as ten minutes occur. The first stop with these rapides is made at Laroche for changing engines, the run being 96.93 miles from Paris, arriving at 10.51 a.m. and due away at 10.56, the average speed on this section being 52.38 m.p.h. From Laroche to Dijon is 98.49 miles—this being the longest non-stop run on the P.L.M.—the arrival time being 12.59 p.m., with a stop of 12 minutes and another engine change. Owing to the long uphill section from Laroche to Blaisy Bas the running average is reduced to 48 m.p.h. The next stop is at Mâcon, 77.98 miles from Dijon, arriving at 2.31 p.m. and having a three-minute stop, the running average on this section being as high as 58.44 m.p.h. ; thence on to Lyon —44.12 miles—arriving at 3.22 p.m., 55.14 m.p.h. being the average speed ; a six minutes' stop is made here for inspections and changes of engines.

To Valence—64.86 miles from Lyon—is run at the high average of 57.18 m.p.h. and is reached at 4.36 p.m. and away at 4.39. On the Valence-Avignon section, which is 78.67 miles, is accomplished the fastest running, as Avignon is reached at 5.58 p.m., at a continuous running average of 59.7 m.p.h. A six-minute stay is booked here again, engines are changed, and leaving at 6.4, Marseille is reached at 7.25 p.m., the 74.87 miles from Avignon being done at 55.44 m.p.h.

After the "Cote d' Azur" rapide the most important train is the "Calais Meditérranée" train de luxe, which is run by the Compagnie des Wagons Lits, etc., in connection with the 11 a.m. from Victoria, and leaving Calais at 2.55 p.m., arriving at Paris (Nord) at 6.35, and thence, via the Petite Ceinture, to Paris (Lyon), arriving at 7.29 p.m. and leaving again at 7.55. The average speed of this train throughout from Paris, exclusive of stoppages, is 52.5 m.p.h., the total time to Marseille being 10hr. 42min., the running time 10hr. 13min., but the load is up to an average of 350 tons. It makes the same stops en route as the "Cote d' Azur." A similar booked train is the "Extra Night Rapide," which is composed of P.L.M. stock and leaves Paris ten minutes in front of the "Calais Meditérranée" and making the same stoppages. The ordinary night rapide—1st class only—leaving at 9 p.m., is timed much slower, taking 11hr. 40min. to Marseille, including total stoppages of 36min., the average speed throughout being as low as 48.42 m.p.h. By way of com-

parison with the rapides, the ordinary 1st and 2nd express, which leaves Paris at 9.15 a.m., takes 13hr. 20min. to Marseille, or 12hr. 20min. running time, but makes an extra stop at Tarascon, the running average of this train being 44.22 m.p.h. The best train taking 3rd class passengers takes 13½ hours, which leaves Paris at 7 p.m. and is due at Marseille at 8.30 a.m. Dealing now with the best up services, the return "Cote d' Azur" necessarily takes first place; leaving Marseille at 11.48 a.m., it is due in Paris at 10.15 p.m.; deducting the stoppages—which on all the up rapides are the same as the down—the booked average speed is 54.36 m.p.h., which necessitates harder running than the down run, as the up road is decidedly more against the engine. The return "Calais Meditérranée," which leaves Marseille at 9.35 p.m., is due at Paris (Lyon) at 8.50 a.m., leaving again at 9.15 for Calais. This train is allowed 11hr. 15min. to make the run from Marseille to Paris, or 10hr. 50min. for actual running, this giving an actual speed of 49.44 m.p.h. The "Extra Night Rapide" is timed six minutes faster, but the 8.15 p.m. from Marseille, the ordinary rapide, is allowed 10hr. 59min. for the actual running, this reducing the average speed to 48.78 m.p.h.

The following are some examples of the actual running performed by the Pacific engines, which are always employed on the Riviera rapides between Paris and Marseille; beyond, along the coast, the trains are hauled by the 4-cylinder 4-6-0 type. Riding down on the footplate with engines Nos. 6013 and 6026 between Laroche and Avignon with the "Cote d' Azur" rapide in March last, the author had a good opportunity of observing the working of these huge machines, and like the 4-6-2 type of the P.O., they are more than equal to the duties called upon them to perform; on this occasion no intermediate timings were taken of the run beyond the arrivals, which were right on time all through to Marseille, excepting at Lyon, owing to the long check through the tunnel due to relaying. It was the intention of timing the "Extra Night Rapide" through from Nice to Lyon on the night of Easter Monday. This train is booked to leave Nice at 3.50 p.m., but unfortunately, owing to the enormous number of passengers returning, the traffic was congested along the whole of the Riviera, trains in some cases being duplicate and even triplicate; the train in question was so considerably delayed and checked that any observations were out of the question so far as the running was concerned. Due to leave Marseille at 8.15 p.m., it was 8.45 before a start was made, and then in duplicate; getting

once clear of the coast traffic a very fine run, which was specially noteworthy, was made to Lyon, arriving only about 12min. late; the load was exceptionally heavy, probably 350 to 360 tons. Making another trip with the "Cote d' Azur" some weeks later, full particulars of the run were recorded. The train had its normal composition as follows: Six-wheels brake van, restaurant car (C.G. des W.L.), two lits salon, three first bogies, restaurant car (C.G. des W.L.), and a six-wheels brake van. At Dijon the latter restaurant car is taken off. The weight of this train to Dijon is approximately 330 tons, but from Dijon the weight would be 286 tons. Starting from Paris with only 51 passengers, and being the last day of the season the train was run, and accommodation being plentiful, first class passengers were picked up and set down from Laroche and beyond, thus relieving the 9.15 a.m. ordinary 1st and 2nd class rapide which would follow. Leaving Paris punctually at 9 a.m. with engine No. 6110, Villeneuve-St.-Georges—9.32 miles from Paris—was passed at 9.10, but soon had a check for 1¼ miles into Brunoy, which was passed at 9.16, 13 miles out; getting away again another tiresome check was received running into Lieusant-Moissy, 19 miles out, which was passed at 9.26, and checked right up to No. 40 Kilo Post (24.85 miles), but from here the road was clear and Melun—27.34 miles—was passed at 9.39¾, Sens—70.21 miles—at 10.21¾, and arriving at Laroche at 10.47¾, 96.93 miles from Paris, and 2¼min. ahead of time, in spite of the checks, the running average throughout being 53.9 m.p.h., but from Melun to Laroche—69.59 miles—the high continuous average of 61.8 m.p.h. was maintained, and on a slightly rising grade. From Laroche the train is taken on by engine No. 6116, and leaving at 10.54, two minutes early, the long continuous pull to Blaisy Bas is undertaken; Tonnere—24.86 miles from Laroche—was passed at 11.24½ at an average of 42 m.p.h. up the bank, but at Kilo Post No. 217 (134.83 miles) there was a severe check for 1¼ miles, but from Nuits-S-Ravieres ascending to Montbard—11.49 miles—was run off in 11½min., the continuous speed being 59.94 m.p.h. Montbard was passed at 11.59½ and Verrey —22.06 miles on—at 12.24½ at a continuous average of 52.9 m.p.h.; from Kilo Post No. 286 (177.71 miles), which is situated on the 15-mile bank of 1 in 125 right up to Blaisy Bas Station—178.95 miles—which is situated at the top of the bank, the train was checked, and eventually stopped just outside the station for 30 seconds, crawled into the station, and held up for another 15 seconds, these checks

being due to the 8.15 a.m. slow train from Paris to Dijon being late. Just over the summit is the Blaisy Bas Tunnel —2.48 miles in length—and through here was experienced a long, slow run, owing to relaying being in progress, but once out of the tunnel and then down the 1 in 125 bank to Dijon, the running was good, but nothing exceptional, the average from the south end of the tunnel at Malain to Velars —6.52 miles—being run at 62.4 m.p.h. and on to Plombiere —2.48 miles—at 54.24 m.p.h. Dijon—195.42 miles from Paris—is scheduled to be reached at 12.59 p.m., but it was actually 1.7½, the average speed throughout from Laroche being reduced to 44.22 m.p.h. by the severe checks, the booked average under normal conditions being 48 m.p.h. over this section. At Dijon the engines are again changed and the train was taken on by No. 6148; the booked time was considerably outstayed, not leaving until 1.19¼ p.m., 8½min. late, but it was not long before the train was well in hand and swinging along down the bank; the run to Beaune—22.68 miles from Dijon—was run off in 23¼min., the running being equal to 59½ m.p.h.; Chagny was passed at 1.50¾, the run from Beaune of 9.62 miles being done at a uniform speed of 69.6 m.p.h.; eight minutes after was a bad check and a slow through Chalon-S-Saone at 2.1 p.m. This unfortunately meant a late arrival at Mâcon, which would otherwise have been reached on time. Passing Sennecey le Grand—247.3 miles from Paris—at 2.11¾, the run of 26.10 miles to Mâcon is another instance of the remarkable capabilities of these engines, the average speed being done at 67.2 m.p.h.; 6.22 miles was run at 70.8 m.p.h. 5.9 miles at 74.4, and 7.15 miles at 63.6 m.p.h. The arrival at Mâcon was 2.35 p.m., being four minutes late, starting again at 2.37½—3½min. late—and getting away in fine style; the next 22.68 miles was accomplished in 24min., to be followed by 8.7 miles in 7¾min., which is equal to 67.2 m.p.h., but the extensive relaying still being in progress through the long tunnel necessitated a check outside and dead slow through, with the result that the arrival at Lyon was 3.28¼—6¼min. late. At Lyon (Perrache) there is a booked stop of six minutes for changing engines, wheel inspections, etc., and although late the full six minutes was taken. From here No. 6160 took the train on, moving away at 3.34¼; another remarkable run was made, the 64.87 miles to Valence being run at 60 m.p.h., and picking up three minutes; some of the intermediate distances were covered as folows: 6.33 miles in 6min., and from Vienne to Valance—45.49 miles—in 43 minutes. At Valence the time

was outstayed by one minute, and starting off at 4.43, four minutes late, another capital run was done and the arrival at Avignon would probably have been right up to time if it had not been for a stop of 1½min. by signal at Bedarides. From Montelimar to Orange is 32.31 miles, and this was run in 29¾min., the p. to p. speed being 64.80 m.p.h., the booked time of arirval at Avignon being 5.58, but it was 6.5 when the train pulled up. Here is allowed a six minutes' stop, and engines again changed, but ten minutes elapsed before a start was made. The train was taken on by No. 6121 to Marseille—74.87 miles—which is the last section. This section is usually pretty hard on the engine, being mostly against collar, and in crossing the vast flat country in the department of Bouches du Rhône, it has been found advantageous to plant poplars on the side of the line to ward off the S.W. gales from the Mediterranean, which would otherwise have a very marked effect on the trains. Avignon was left at 6.15 p.m., and Tarascon passed at 6.29½—13.05 miles—in 14½min., Arles—8.39 miles from Tarascon—in 9¾min., but at Miramas, owing to a bridge repair, necessitated another bad check, with the result that Marseille was reached 16min. late, the arrival time being 7.41 instead of 7.25, but nevertheless, some remarkable work was done during a run of 535.93 miles, practically the whole distance being done in a driving rain, the total booked running time being 9hr. 50min., and the actual 10hr. ¾min. As a good example of engine running with an ordinary train the author made a fine run up with the 9 a.m. 1st and 2nd rapide from Marseille, and of which a log is appended.

From the foregoing remarks of the work accomplished it is shown in a striking manner what may be done when a compound engine is equipped with a super-heating apparatus. In French locomotive practice for express work as it stands to-day, three combined main features stand out in prominence, *i.e.*, 1st, the 4-6-2 type of engine ; 2nd, the 4-cylinder compound ; 3rd, super-heating. From the work which has been quoted of engines combining these three principles, it is highly improbable if it would have been accomplished in so satisfactory a manner if saturated steam and 2-cylinder engines had been employed. In no instance of any of these runs were the engines unduly pressed, and always maintaining a good head of steam, with the exception of one case, when an engine gave a little trouble in steaming, but in this instance it was probably more due to the fireman. Locomotive engineers in France have perhaps experimented more than most countries in

Europe, and especially as regards to compounding, and have not been slow to realise the advantages from the combined compound super-heater, and it may safely be said that if the steam locomotive is to maintain its position in the traction of the future, it must be built on the principles mentioned. In France, as in other countries, the locomotive departments have continuously to be coping with the demand from the traffic department for increased engine power, and the cry is always for more, with the result, in order to accommodate the increased boiler dimensions made necessary for handling the traffic, the 4-2-6 compound non-super-heater was introduced by the P.O. in 1907, subsequently to be followed by the 4-cylinder compound super-heater. 1909 saw the introduction of the first Pacific on the P.L.M., and when this type of engine came out it was built as a compound non-super-heater, to be followed by a non-compound super-heater and then again by a compound super-heater, with the result that, after exhaustive trials, the two original engines were converted to the same principle as the third engine, so that about 70 engines of this type are now running on the P.L.M. At the close of last year (1912) this type of engine was introduced on the Nord, and they are now replacing the compound Atlantics on the heaviest trains. Appended at the end of this paper is a table giving the principal dimensions of the locomotives referred to in this paper. In conclusion, the author has to tender his thanks to the following gentlemen who have so kindly rendered assistance and given facilities to enable the author to compile his observations: M. Asselin, chemin de fer du Nord, M. Solacroup, chemin de fer de Paris a Orleans, M. Marechal, chemin de fer du P.L.M., and M.M. Société Alsacienne de Constructions Mécaniques á Belfort.

DISCUSSION.

The Chairman **(Mr. Lelean)**: It seems there are three ways of designing a locomotive. The first is to take the theoretical formula straight away from the text book, the second is to take these formula, but modify them by the particular train resistances of the line you are considering as determined experimentally. The third way is to take the records of the performance of a known engine, such as our Secretary seems to have done on these runs, and from these valuable records determine very much more accurate data for guidance in designing future engines for that line. The Great Western Railway of this country bought some engines from France, with the object of giving them a fair trial. There were certain advantages gained by this policy, although the engines were not found to be superior to their own engines on the whole. Since that time there have been some very fine engines designed in England, both on the Great Western and on other lines, and it must not be assumed that French engines are superior to English ones, although for their own line they may do very satisfactory work.

Mr. Woolford: This is rather a difficult paper to speak on at all, because it is really a record of things that happened, and of the observation of the reader of the paper. It will no doubt be very interesting to read when we get it printed, especially if we have a map and follow some of the names of the places. They did not seem to me very familiar, and I could not form a clear idea of their relative situations. Consequently, the paper is rather difficult to criticise.

One thing I was rather glad to see, and that was, the writer did not claim any sensational speeds. As far as I can remember, 77 miles per hour was the fastest recorded. This is probably due to most of the engines being equipped with speed recorders. The man who times with a stop-watch usually talks of speeds of 90 miles an hour, or something like that. I always look with doubt on that kind of figures; I do not think they are actually run. I have had personally a good deal of running, and the fastest I have ever managed to get by careful calculation was about 76 to 77 miles an hour, and I have looked on 80 miles an hour as the outside speed we can possibly get under ordinary conditions. They will be probably made down hill with a

fairly light train. Some years ago a number of very sensational speeds were given; Mr. Rous Marten gave some of them, I believe. Possibly some of them *were* attained. They *had* to make excessive speed down hill to get over the time lost by reason of the very low speeds they ran up hill, with some of the old single engines for instance.

On one or two other points in the paper a little further explanation might be given. One thing, what fuel were the engines burning; and generally, what kind of steam pressure are the boilers pressed at. The author spoke about some of the temperatures of superheat; I should like a little explanation. If the temperatures given are the maximum temperatures, inclusive of the saturated steam heat, I think some very low, and if the temperature given is actually the superheat above the saturated temperature, then some of the later figures were rather high. I think you gave 308° as the lowest temperature in your figures, if that is added to the saturated heat, then the steam pressure is very low, but if it is on top of it, the other figures given must be excessively high, as, if I remember rightly, some over 500° were given. I think that 300° superheat above the saturated heat is looked upon as about the maximum that ought to be run. I assume that they were Fahrenheit degrees.

One other little point I should like to know; is the gauge of the rails of the French railways exactly the same as the English gauge, because I fancy there is a very slight difference, so that I think English engines and trains could run in France, but French engines and trains could not run in England. I think the gauge is very slightly different. Perhaps Mr. Burtt will tell us if this is so.

Mr. E. W. Taylerson: Mr. Burtt did not mention the pressure they generally work at over there.

I have before me one or two notes concerning the "Cornish Riviera" Express, on the G.W.R., Paddington to Plymouth. The train is composed of 11 8-wheelers and one 12-wheeler to Exeter, and there two coaches are slipped, and from thence to Plymouth the load is nine 8-wheelers and one 12-wheeler. The total weight is 400 tons to Exeter and 300 beyond. The miles to run without a stop are 226½, average speed, 59 miles per hour to Westbury, and for the whole trip, 55 miles per hour. The gradients after Newton Abbot are 1 in 40. The engines employed are of the 4-cylindered simple type; tractive force, 26,500 lbs.; grate area, 27.57 square feet. Superheat, 500-550°. The

steam pressure is 225 lbs. per square inch, and the driving wheels are 6ft. 8½in. diameter. Piston valves, 8in., Walschaerts valve gear. The coal consumption is from 30 to 32 lbs. per mile. The time occupied on the run from Paddington to Plymouth is 4 hours 7 minutes.

I think this compares very favourably with some of the runs made between Paris and Orleans, etc. The stops seem to be far more frequent on the Continental railways than on many of the English railways.

Mr. Taylerson, jun.: I should like to ask the author whether this kind of French engines suffer from the same complaint that a good many of ours do at the present time, that is, the emission of sparks, and whether they can control them by either bigger blast pipes, or less draught. I have been told that on a good many of these "trains de luxe" they burn Welsh coal. I should like to know whether it is usual, and what class of trains burn it. I believe the great majority of the trains, "omnibus" and "rapide," burn the ordinary briquettes. What class were these compounds burning, briquettes or Welsh coal?

Mr. Tilling: At the end of his paper, Mr. Burtt summarised the tendencies of modern French practice, and he says they are using the superheater along with compounding. That seems altogether different to what we get over here. I was considering whether we have that at all, and I thought of the Midland compounds. I do not know any other instances.

In speaking of the Paris-Orleans line, Mr. Burtt said how these very large engines contrasted with the very old ones passed on the line. Well, we should remember that it is as I read some years ago on that line; up to about 1905 they had not had for 15 years a single new engine, so that really their locomotives are divided into two periods, so to speak—very old ones, and quite new ones—a great contrast. Perhaps the author can say if water troughs are used in France.

Mr. A. C. C. Damant: There was one point I noticed about Mr. Burtt's paper, there was very little mention of speed orders. They seem to have some very long runs and no speed orders at all, practically. One company, at any rate, in this country, has several, a good many at junctions, and also at stations. This makes a considerable difference in the running of a non-stop train. On many of the English lines there is a limit of 20 miles per hour several times on a long

run. Mr. Burtt does not mention anything like that. If you have to reduce from 50 or 60 miles an hour to about 25 every quarter of an hour, it is going to make your average considerably lower. It seems we may take it that on long runs there are practically no speed limits.

Mr. Lawrence: I should like to ask Mr. Burtt if he can say whether the engines that were fitted with water-tubes some time back are giving good results and if that design is being perpetuated.

The Chairman then called on Mr. Burtt to reply.

Mr. Burtt: Mr. Chairman and Gentlemen, I must thank you very much for the reception you have given my paper this evening. The discussion has perhaps not been of such a vigorous nature as I should have liked, but that no doubt is due to the reason that the paper is somewhat difficult to discuss as it deals more with fact than with opinion. As to why I wrote on this subject, the reason is, that as I had the facilities placed at my disposal to observe the working of the locomotives of the most modern French practice, it seemed to me that it would be of interest if the observations were recorded as representative of the practice prevailing in France at the present time, especially so, as it is not far back to the time when the railway conditions were of a very mediocre order. Mr. Lelean has referred to the French compounds on the Great Western Railway which were purchased some few years ago. The results were presumably sufficiently satisfactory to justify two more being purchased, but of larger dimensions than the original one, and all three worked in conjunction with their own Atlantics. Some very notable runs have been made with these three French engines, some of which the late Mr. Rous-Marten has chronicled from time to time in the columns of the "Engineer." Reference was made to the longest non-stop run from Paris to Busigny, 112.47 miles, which of course is nothing to be compared with many English non-stop runs. I think I am correct in saying that the longest non-stop run in France is done on the Etat, from Chartres to Thouars, a distance of 147 miles, of which there are two booked runs of 52.5 m.p.h. Water troughs are made use of on this run and are the only ones laid down in France. Undoubtedly the finest non-stop run we have in this country is the G.W. Railway 10.30 a.m. Paddington to Plymouth, but the fastest start to stop run is on the North-Eastern, from Darlington to York, which has a booked speed of 61 miles 43 chains

per hour. Regarding Mr. Woolford's comments on high speeds, phenomenal ones, I think, are rare in France like we hear of from time to time taking place in England and the United States, and as the speaker said are more in the imagination of the recorder than in reality. Of course high speeds have been attained on special runs in England. Some years back, during a series of trials with one of the 4-4-0 engines on the L.B. and S.C. Railway some exceptional speeds were attained, the highest being just over 90 m.p.h. down the 1 in 264 bank through Haywards Heath.

Reference has been made to the fuel, which in nearly all cases is briquettes, a composition of coal dust and pitch. A small amount of Welsh coal does find its way into France, but this is usually confined to engines running the trains de luxe. With reference to the question which was raised concerning the steam pressures, it is the same in the case of all the compounds—227.5 lbs. per square inch—which is high considering they superheat, but no doubt is kept at this pressure due to the compounding. A question was raised as to the temperature of the superheated steam, the figures I gave referred to the actual temperature of the steam. The engine on the occasion referred to was not doing so well perhaps as it might have done, but it was probably more due to the fireman than the engine, as the former, I am of opinion, was rather fresh to the class of engine he was on, the fire being occasionally attended to by the engineman, there being an inspector on the footplate at the time. Regarding the gauge of line, it is slightly wider than the English, and as a matter of fact I am given to understand that no two lines are actually the same, but it is only a question of a few millimetres.

Mr. Tilling referred to the compound superheater. I believe there is only one in this country, which they have just converted at Derby, one of their compounds having been fitted with a superheater.

Mr. Damant referred to speed orders. In France it is the law for every engine, passenger or goods, to be fitted with a speed indicator, and every line and every section of a line has a maximum speed fixed to it. They mostly use the Flaman Speed Indicator, which has a red pointer to it, and the driver sets this pointer to the maximum for the section of the line he is on, so that he can always see that he is not exceeding the prescribed speed for that section. The maximum speed allowed is 120 kilometres—74.56 miles—per hour. It probably is not often attained and still less

exceeded, but there may be times when they just run over it, as, if trains are late, time is invariably made up. I mentioned that since the introduction of the Pacific engines, with their great adhesive weight, the speeds up the banks are always tolerably high, so there is no necessity for the fast running down the other side. It was different in the old days when they ambled up the bank, and made up time going down the other side. And as was mentioned in the Paris-Bordeaux runs, the highest speed at any time did not exceed 64 m.p.h. There is not the network of lines in France that there is in England. You may go many miles without coming to any junction, so that there is not the necessity for speed orders. At Creil, which is an important junction, Amiens, and at Boulogne, where there is a sharp curve, are practically the only speed limits between Paris and Calais, 185 mile run.

Mr. Lawrence asked a question about water-tubes. So far as I am aware, there were only two of these engines in France. The first was the 4-4-4 tender engine, which was introduced about five years ago on the Nord, and I think has not given a large measure of satisfaction, and has now been converted to an ordinary 4-6-0. About two years ago the Nord brought out what I think were the first Baltics, 4-6-4 type, ever introduced. One was a water-tube engine, and one had the ordinary boiler. That water-tube engine has given some trouble, I believe, with the water-tubes.

Referring to cinder throwing; as far as I am aware, nearly all the engines are fitted with spark arresters; with regard to the blast pipe, practically every engine has fitted a blast pipe control, which can be reduced or enlarged at the discretion of the driver. These new engines on the Nord have a tapered spark arrester, which can be raised or lowered in the blast pipe, operated from the cab, and which we should call over here a razor.

In conclusion, sufficient has been said, it is hoped, to give a fair idea of the general trend of locomotive design in France, as shown by the engines recently constructed by some of the principal locomotive works.

Whilst in the case of some of the engines mentioned, the author is confined to seeing them at work on the road, a number of them have come under notice at the works of the builders, and for these he is indebted to the makers for detailed information supplied. To these and to the locomotive engineers, inspectors, and other officials who have so kindly assisted, the writer wishes to make cordial

acknowledgments of their kindness. All distances have been taken on the metric system and then converted to British units, as have all dimensions. The author has done his best to check all calculations, but as they have involved many hundreds of conversions, possibly some errors may be discovered.

Mr. Bennett proposed that a hearty vote of thanks be accorded to Mr. Burtt for his paper, which all in their different ways had found interesting. This proposition was seconded by Mr. Taylerson, sen., to which the author replied.

The Chairman announced the date of the next meeting, November 1st, when Mr. Bennett would read a second paper on "The Examination, Defects and Repairs of Locomotive Boilers."

CORRESPONDENCE.

MR. J. F. GAIRNS:—"I am sorry that I was unable to be present at the meeting, but I have been privileged to read Mr. Burtt's paper privately, and in reference to which I should like to make a few comments. Not possessing intimate acquaintance with the French railways I am not qualified to criticise his contribution, even if there were occasion therefor, which I doubt. Indeed, I would rather offer my congratulations on its thoroughness and interest; and my remarks are more in the direction of comments concerning phases suggested by the paper. The 'Pacific' locomotive has undoubtedly come to stay in France, but it would appear that, speaking generally, these engines are used for very fast trains, whereas there is a tendency elsewhere to use them for heavy rather than specially fast work. If I remember rightly, on the Paris-Orleans line there are both express and mixed traffic 'Pacifics'; but on other lines, as well as on the P.O. for the large wheeled class, the fast schedules seem to render the use of these big engines necessary to cope with demands, although in many instances the loads, while considerable, hardly appear to be extreme. One cannot help contrasting our own practice for duties of this character. Many of our fastest trains are relatively lighter, and I think most railways reckon that with about 300 tons the limit is nearly attained as regards time keeping. Yet, when one compares the work of many of our 4-4-0 class with bigger loads or with, say, 300 tons on fast schedules, the comparisons appear to be nearly equal, while with our big 4-6-0 and 4-4-2 classes there may be, in some cases at all events, the suggestion that French engines have the best of it. At the same time the relative fewness of notable schedules, and the necessity for confining attention to them for special work, is in striking contrast to the large variety of work of an interesting character which can be recorded, and many times every day, on the British main lines. Moreover, the question arises whether the matter is not one of conditions rather than of facts. For long international journeys, the completion in reasonable times and the necessity for inter-connections all over the Continent, as well as the slow speeds always inevitable at many places, call for special work on the straightforward sections. Furthermore, in very long

journeys, there is an appreciable difference between an average of, say, 56 and 59 miles an hour, whereas in our limited area, the few minutes represented thereby are hardly worth working for. At the same time it must be acknowledged that the French lines produce wonderful results, and due credit must be accorded to the designers of these engines by which they are carried out."

MR. KRUG, Bar le Duc:—"Just recently on the Est I have been timing some of the ordinary expresses and send you a few details, which may be of interest. One of the runs was from Bar le Duc to Rheims Betheny, 135 kilos (83.88 miles), with two stops—at Blesmes, 36.5 kilos (22.68 miles) from Bar le Duc, and Châlons, 81 kilos (50.33 miles) from Bar le Duc, booked time of the journey including stops 1 hour 37 minutes, actual time 1 hour 31 minutes 7 seconds = 88.8 kilos per hour (55.17 m.p.h.). The stops were 37 seconds at Blesmes, and 2 minutes 44 seconds at Châlons, net time 1 hour 27 minutes 46 seconds = 91 kilos per hour (56.54 m.p.h.). Bar le Duc to Blesme, start to stop, 36.5 kilos (22.68 miles) in 24 minutes = 56.64 m.p.h., maximum of 77.05 m.p.h. reached in two places. Blesme to Châlons, start to stop, 45 kilos (27.96 miles) in 27 minutes 39 seconds = 60.62 m.p.h.; speed of 70-71 m.p.h. frequently reached. Châlons to Rheims Betheny, gradients of 6%, 10%, and 11.5%, 54 kilos (33.55 miles) in 36 minutes 5 seconds = 55.92 m.p.h., with a slack at St. Hilaire junction, maximum of 77.05 (124 kilos) attained in several places, 18 kilos (11.18 miles) was run in 9 minutes 12 seconds. Engine No. 3,212, 4-cylinder, 4-6-0 type, with load of seven bogies and two vans—250-255 tons. Last week between Bar le Duc and Nancy I made a run of 99 kilos (61.51 miles) in 1 hour 11 minutes 30 seconds with eight bogies, making three intermediate stops, several kilos (0.621 miles) were run in 29 seconds = 124 kilos (77.05 miles per hour), the gradients being 8% in both directions."

PRINCIPAL DIMENSIONS OF ENGINES REFERRED TO IN PAPER.

	P.L.M.	P.O.	NORD.
Cys. (2) dia. H.P. ...	16.35 in.	16.53 in.	16.14 in.
,, ,, L.P. ...	24.4 ,,	25.19 ,,	23.62 ,,
Stroke of pistons ...	25.59 ,,	25.59 ,,	25.98 ,,
Dia. coup. wheels ...	6 ft. 6 11/16 in.	6 ft. 4.76 in.	6 ft. 8.31 in.
Boiler dia. ex. ...	5 ,, 6 ,,	5 ,, 4.6 ,,	5 ,, 6.14 ,,
Length between tube plates	19 ,, 8 ,,	19 ,, 4.28 ,,	14 ,, 9.16 ,,
Length firebox at bottom	6 ,, 10 ,,	—	—
Tubes	(143) 2.16 ,,	—	—
,, ...	(28) 5.23 ,,	—	—
H.S. firebox ...	171 sq. ft.	172.22 sq. ft.	182.98 sq. ft.
,, tubes	2190 ,, ,,	2105.47 ,, ,,	2077.45 ,, ,,
,, total	2361 ,, ,,	2277.69 ,, ,,	2260.43 ,, ,,
Grate area	45.7 ,, ,,	45.96 ,, ,,	34.01 ,, ,,
Boiler pressure ...	227.5 lbs.	227.5 lbs.	227.5 ,, ,,
Weight in working order	91 T. 17 C.	Light. 83.16 T.	Light. 75 T.
Adhesive weight ...	54 T. 12 C.	—	—
Tender water capacity	6160 galls.	4350 galls.	—
,, coal ,,	5 tons.	6 tons.	—
Weight in working order	59 T. 12 C.	49 T. 12 C.	—
Total weight E. and T. in working order	151 T. 9 C.	133 T. 8 C.	—

CHEMIN DE FER DU NORD.

LOG No. 1.

MAY 16TH, 1913.

TRAIN No. 5.—9.55 A.M., PARIS TO CALAIS MARITIME.

Miles from Paris.	Miles from S. to S.	Station.		Booked Time.	Actual Time.	Point to Point Speed.	Remarks.
—	—	Paris Nord	dep.	9.55	9.56½	—	
3.72	3.72	St. Denis	pass	—	10.2½	35.4	
20.61	17.89	Orry-la-Ville	,,	—	10.20	61.2	Passed at 77.5 m.p.h.
25.30	3.69	Chantilly	,,	—	10.25	43.92	,, 69 ,,
31.07	5.77	Creil	,,	—	10.32	49.44	,, 50 ,,
40.32	9.25	Clermont	,,	—	10.42	55.5	,, 62.13 ,,
—	—	Avrechy	,,	—	10.46½	—	,, 62.13 ,,
49.27	8.94	St. Just	,,	—	10.52	53.64	Between St. Just and Breteuil,
58.78	9.5	Breteuil	,,	—	11.0¾	64.80	p.w. check to 18 m.p.h.
64.55	5.77	La Faloise	,,	—	11.6	65.40	Passed at 74.5 m.p.h.
68.84	4.28	Ailly-sur-Noye	,,	—	11.9¾	68.4	,, 74.5 ,,
75.61	6.77	Boves	,,	—	11.15¾	67.68	,, 74.5 ,,
80.9	5.28	Amiens	,,	—	11.20½	70.2	,, 30 ,,
86.74	5.84	Ailly-sur-Somme	,,	—	11.27½	50.04	,, 70 ,,
89.66	2.92	Picquigny	,,	—	11.30¼	63.6	,, 71.5 ,,
93.95	4.28	Hangest	,,	—	11.34	66.4	,, 65.23 ,,
97.87	3.91	Longpré	,,	—	11.37½	66.6	,, 71.45 ,,
100.97	3.1	Fontaine-sur-Somme ...	,,	—	11.40½	61.8	,, 66¾ ,,
103.33	2.36	Pont-Remy	,,	—	11.43	62.4	Between Pont Remy and Abbe-
108.73	5.4	Abbeville	arr.	11.48	11.49	54.0	ville, p.w. check.
—	—	,, ...	dep.	11.51	11.52	—	
113.77	5.03	Pont-le-Grand	pass	—	12.0	37.68	Passed at 41.9 m.p.h.
117.18	3.41	Noyelles	,,	—	12.3½	58.2	,, 62.13 ,,
123.33	6.15	Rue	,,	—	12.9¼	64.2	,, 64.80 ,,
—	—	Quend-Fort Mahon ...	,,	—	12.13	—	
129.61	6.27	Conchil-le-Temple ...	,,	—	12.15	65.4	,, 62.13 ,,
—	—	Rang-du-Fliers	,,	—	12.19	—	,, 62.13 ,,
136.63	7.02	St. Josse	,,	—	12.21¾	62.4	,, 62.13 ,,
140.36	3.72	Etaples	,,	—	12.25½	59.4	,, 59 ,,
148.49	8.13	Neufchatel	,,	—	12.35	51.0	,, 44 ,,
151.65	3.16	Hesdignuel	,,	—	12.37¾	66.4	,, 67.20 ,,
158.43	6.77	Boulogne Tints.	,,	—	12.44	64.8	,, 60 ,,
161.43	3.0	Wimille-Wimereux ...	,,	—	12.48¾	37.8	,, 36.60 ,,
168.19	6.76	Marquise-Rinxent ...	,,	—	12.55½	60.06	,, 56 ,,
—	—	St. Guines	,,	—	1.3½	—	,, 46.6 ,,
179.08	10.88	Frethun	,,	—	1.8¼	51.0	,, 77¾ ,,
—	—	Les Fontinettes	,,	—	1.10¼	—	,, 65 ,,
183.28	4.2	Calais Ville	,,	—	1.12	67.2	,, 40 ,,
184.92	1.61	,, Maritime	arr.	1.10	1.16	24.12	

Booked average speed, Paris-Abbeville	57.72	m.p.h.
Actual ,, ,, ,, ...	57.84	,,
Booked average speed, Abbeville-Calais	57.84	,,
Actual ,, ,, ,, ...	54.42	,,
Booked total time, Paris-Abbeville	113	mins.
Actual ,, ,, ...	112¾	,,
Gain	¼	,,
Booked total time, Abbeville-Calais	79	,,
Actual ,, ,, ...	84	,,
Loss	5	,,
*Booked total time, Paris-Calais	192	,,
Actual ,, ,, ...	196¾	,,

WEATHER—Fine.

WIND—Head, moderate.

ENGINE—No. 3.1154, built at Belfort, 1912.

CLASS—4-6-2, four-cys. compound superheater.

LOAD—391.7 tons, inclusive of passengers and luggage.

* Time at Abbeville deducted.

CHEMIN DE FER DU NORD.

LOG No. 2.

MAY 11TH, 1913.

TRAIN No. 18.—2.50 P.M., CALAIS MARITIME TO PARIS.

Miles from Calais.	Miles from S. to S.	Station.	Booked Time.	Actual Time.	Point to Point Speed.	Remarks.
—	—	Calais Maritime ... ... dep.	2.50	2.50	—	
1.61	1.61	,, Ville ... ... arr.	2.54	2.56	24.12	
—	—	,, ,, ... dep.	2.56	2.58	—	
11.30	9.69	Caffiers ... ... pass	—	3.13	38.76	
26.49	14.19	Boulogne Tints. ... ... ,,	—	3.27	47.94	Slack to 40 m.p.h. for Boulogne curve.
44.56	18.07	Etaples ... ... ,,	—	3.45½	59.56	
76.19	31.63	Abbeville ... ... ,,	—	4.17¾	58.80	
87.05	10.86	Longpré ... ... ,,	—	4.29½	55.44	
104.02	16.97	Amiens ... ... arr.	4.54	4.49	52.20	Slack outside Amiens to 12 m.p.h.
—	—	,, ... dep.	4.59	4.54½	—	
135.65	31.63	St. Just ... ... pass	—	5.28¼	55.80	
144.60	8.94	Clermont ... ... ,,	—	5.37½	57.96	
153.85	9.25	Creil ... ... ,,	—	5.47½	55.5	
159.62	5.77	Chantilly ... ... ,,	—	5.54¼	51.0	Long slack to 6 m.p.h. from La Chapelle.
184.92	26.30	Paris Nord ... ... arr.	6.30	6.24	52.8	

Booked average speed, Calais Ville-Amiens	51.96	m.p.h.
Actual ,, ,, ,, ...	55.32	,,
Booked average speed, Amiens-Paris	53.27	,,
Actual ,, ,, ...	54.18	,,
Booked total time, Calais Ville-Amiens	118	mins.
Actual ,, ,, ,, ...	111	,,
Gain	7	,,
Booked total time, Amiens-Paris	91	,,
Actual ,, ,, ...	89½	,,
Gain	1½	,,
*Booked total time, Calais Ville-Paris	207	,,
Actual ,, ,, ,, ...	200½	,,

WEATHER—Fine.

WIND—Nil.

ENGINE—No. 3.1156, built at Belfort, 1912.

CLASS—4-6-2 four cys. compound superheater.

LOAD—320 tons, inclusive of passengers and luggage.

* Time at Amiens deducted.

CHEMIN DE FER DU NORD.

LOG No. 3.

JUNE 3RD, 1913.

TRAIN No. 9.—12 NOON, PARIS-CALAIS MARITIME.

Miles from Paris.	Miles from S. to S.	Station.		Booked Time.	Actual Time.	Point to Point Speed.
—	—	Paris	dep.	12.0	12.0	—
31.07	31.07	Creil	pass	—	12.32	58.2
80.9	49.83	Amiens	arr.	1.26	1.25½	54.6
—	—	,, ...	dep.	1.32	1.30½	—
108.73	27.83	Abbeville	pass	—	2.0	58.2
158.43	49.70	Boulogne T.	,,	—	2.50	59.64
183.28	24.85	Calais Ville	arr.	3.25	3.18½	51.6

Booked average speed, Paris-Amiens	56.43	m.p.h.
Actual ,, ,, ,, ...	56.77	,,
Booked average speed, Amiens-Calais Ville	54.06	,,
Actual ,, ,, ,, ...	56.82	,,
Booked total time, Paris-Amiens	86	mins.
Actual ,, ,, ...	85½	,,
Gain	½	,,
Booked total time, Amiens-Calais Ville	113	,,
Actual ,, ,, ,, ...	108	,,
Gain	5	,,
*Booked total time, Paris-Calais Maritime	199	,,
Actual ,, ,, ,, ...	193½	,,

WEATHER—Fine.

WIND—Nil.

ENGINE—No. 3.1157, built at Belfort, 1912.

CLASS—4-6-2 four cys. compound superheater.

LOAD—350 tons, inclusive of passengers and luggage.

* Time at Amiens deducted.

CHEMIN DE FER DE PARIS A ORLEANS.

LOG No. 4.

MAY 12TH, 1913.

TRAIN No. 7.—9.46 A.M., PARIS TO BORDEAUX (ST. JEAN).

Miles from Paris.	Miles from S. to S.	Station.		Booked Time.	Actual Time.	Point to Point Speed.	Mins. Gain.	Mins. Lost.	Remarks.
—	—	Paris Quai D'Orsay ...	dep.	9.46	9.46	—			
3.72	3.72	,, Quai D'Austerlitz ...	arr.	9.52	9.52	37.20			
—	—	,, ,, ...	dep.	9.56	9.58½	—			
22.98	19.26	Bretigny	pass	—	10.24½	44.40			
38.51	15.53	Etampes	,,	—	10.40	60.60			
78.90	40.39	Orleans les Aubrais ...	arr.	11.22	11.21¾	58.02	2¾		
—	—	,, ,, ...	dep.	11.26	11.27¼	—			
115.56	36.66	Blois	pass	—	12.6¼	56.40			
150.36	34.80	Tours, S. Pierre-des-Corps	arr.	12.42	12.40	61.80	3¼		
—	—	,, ,, ,,	dep.	12.49	12.49¾	—			
213.12	62.76	Poitiers	arr.	2.4	1.59¼	54.18	5½		
—	—	,, ...	dep.	2.9	2.10¾	—			
282.72	69.60	Angoulême	arr.	3.27	3.27	54.72	1¾		
—	—	,, ...	dep.	3.33	3.34	—			
366.6	83.88	Bordeaux, St. Jean ...	arr.	5.7	5.8½	53.22		½	Checked at 4.7 p.m. to 6 m.p.h. for bridge under repairs. Arrived outside Bordeaux at 5.7½, dead slow into station.

Total booked time on journey ... ... 7 hrs. 21 mins.
Total booked running time on journey ... ... 6 ,, 55 ,,
Total actual time on journey ... ... 7 ,, 22½ ,,
Total actual running time on journey ... ... 6 ,, 42¼ ,,
Total gain on booked working time ... ... 11½ ,,
Average speed, Paris-Orléans ... ... 54.18 m.p.h.
,, Orléans-Tours ... ... 58.92 ,,
,, Tours-Poitiers ... ... 54.18 ,,
,, Poitiers-Angoulême ... ... 54.72 ,,
,, Angoulême-Bordeaux ... ... 53.22 ,,

WEATHER—Wet from Etampes-Bordeaux.
WIND—Head, moderate.
ENGINE—No. 3561, built at Belfort, 1912
CLASS—4-6-2 4-cys. comp. superheater } Paris Austerlitz-Tours.
ENGINE—No. 3551, built at Belfort, 1912
CLASS—4-6-2 4-cys. comp. superheater } Tours-Bordeaux.
LOAD—Paris to Tours, 370 tons, inclusive of passengers and luggage.
,, Tours to Bordeaux, 295 tons, inclusive of passengers and luggage.

CHEMIN DE FER DE PARIS A ORLEANS.

LOG No. 5.

MAY 13TH, 1913.

TRAIN No. 34.—11.4 A.M., BORDEAUX (ST. JEAN) TO PARIS.

Miles from Bordeaux.	Miles from S. to S.	Station		Booked Time.	Actual Time.	Point to Point Speed.	Mins. Gain.	Mins. Lost.	Remarks.
—	—	Bordeaux, St. Jean ...	dep.	11.4	11.10	—			
32.93	32.93	Coutras	pass	—	11.46	54.84			
—	—	Le Moulin Chatenier ...	,,	—	12.12½	—			Checked at Le M. Chatenier to 20 m.p.h.
83.88	50.95	Angoulême	arr.	12.38	12.41	55.56	3		
—	—	,, ...	dep.	12.42	12.46	—			
153.48	69.60	Poitiers	arr.	2.1	2.1	55.68	4		
—	—	,, ...	dep.	2.6	2.10¼	—			
174.6	21.12	Châtellerault	pass	—	2.33	55.68			
216.24	41.64	Tours, St. Pierre-de-Corps	arr.	3.16	3.17	56.76	3¼		
—	—	,, ,, ,,	dep.	3.24	3.30¼	—			
231.15	14.91	Amboise	pass	—	3.46½	55.02			
251.03	19.88	Blois	,,	—	4.6¾	58.86			
287.70	36.67	Orleans, Les Aubrais ...	arr.	4.40	4.46½	55.32		¼	
—	—	,, ,, ...	dep.	4.45	4.52½	—			
308.2	20.5	Toury	pass	—	5.15½	53.46			
328.09	19.89	Etampes	,,	—	5.34½	62.40			
343.62	15.53	Bretigny	,,	—	5.50¾	57.36			
362.88	19.26	Paris, Quai D'Austerlitz...	arr.	6.7	6.14¼	49.14	¼		
—	—	,, ,, ...	dep.	6.10	6.18½	—			
366.6	3.72	,, Quai D'Orsay ...	arr.	6.16	6.26½	27.9		2	

Total booked time on journey ... ... 7 hrs. 12 mins.
Total booked running time on journey ... ... 6 ,, 47 ,,
Total actual time on journey ... ... 7 ,, 16½ ,,
Total actual running time on journey ... ... 6 ,, 38¾ ,,
Total gain on booked working time ... ... 10½ ,,
Average speed, Bordeaux-Angoulême ... ... 55.26 m.p.h.
,, Angoulême-Poitiers ... ... 55.68 ,,
,, Poitiers-Tours ... ... 56.22 ,,
,, Tours-Orleans ... ... 56.72 ,,
,, Orleans-Paris ... ... 55.72 ,,

WEATHER—Fine.
WIND—Nil.
ENGINE—No. 3553, built at Belfort, 1912
CLASS—4-6-2 4-cys. comp. superheater } Bordeaux-Tours.
ENGINE—No. 3557, built at Belfort, 1912
CLASS—4-6-2 4-cys. comp. superheater } Tours-Paris.
LOAD—304 tons, inclusive of passengers and luggage.

CHEMIN DE FER DE P.L.M.

LOG No. 6.

MAY 14TH, 1913.

TRAIN No. 15.—9.0 A.M., PARIS TO MARSEILLE (ST. CHARLES).

Miles from Paris.	Miles from S. to S.	Station.		Booked Time.	Actual Time.	Point to Point Speed.	Remarks.
—	—	Paris	dep.	9.0	9.0	—	
9.32	9.32	Villeneuve St. G. ...	pass	—	9.10	55.92	Checked between these stations at Brunoy and Lieusaint.
27.34	16.02	Melun	,,	—	9.39¾	32.28	
36.66	9.32	Fontainbleau	,,	—	9.51¾	46.56	
49.08	12.42	Montereau	,,	—	10.3¼	61.80	
70.21	21.13	Sens	,,	—	10.21¾	68.40	
90.40	20.19	Joigny	,,	—	10.40½	64.20	
96.93	6.53	Laroche	arr.	10.51	10.47¾	54.00	
—	—	,, ...	dep.	10.56	10.54	—	
107.18	10.25	St. Florentin V.	pass	—	11.8½	42.36	
121.79	14.61	Tonnerre	,,	—	11.24½	54.78	Checked between these stations.
139.49	17.70	Nuits-sous-Ravieres ...	,,	—	11.48	45.18	
150.99	11.50	Montbard	,,	—	11.59½	60.00	Checked between these stations.
173.05	22.06	Verrey	,,	—	12.24½	52.92	
178.95	5.90	Blaisy Bas	arr.	—	12.42½	19.62	
—	—	,, ...	dep.	—	12.42¾	—	
183.61	4.66	Malain	pass	—	12.54½	23.76	
190.14	6.53	Vélars	,,	—	1.0¾	62.40	
192.62	2.48	Plombière	,,	—	1.3½	54.12	
195.42	2.80	Dijon	arr.	12.59	1.7½	42.00	
—	—	,, ...	dep.	1.11	1.19¼	—	
218.10	22.68	Beaune	pass	—	1.42½	57.24	
227.73	9.63	Chagny	,,	—	1.50¾	69.60	Checked between these stations.
—	—	Chalon S. Sâone	,,	—	2.0½	—	
247.30	19.57	Sennecy-L.-Grand ...	,,	—	2.11¾	55.86	
253.52	6.22	Tournus	,,	—	2.17	70.80	
259.42	5.90	Uchizy	,,	—	2.21¾	74.40	
266.57	7.15	Sénogan	,,	—	2.28½	63.60	
273.40	6.83	Macon	arr.	2.31	2.35	54.60	
—	—	,, ...	dep.	2.34	2.37½	—	
296.08	22.68	Villefrance-sur-S. ...	pass	—	3.1½	56.70	Checked between these stations.
304.78	8.70	St. Germain	,,	—	3.9¼	67.20	
317.52	12.74	Lyon (Perrache)	arr.	3.22	3.28¼	40.20	
—	—	,, ,, ...	dep.	3.28	3.34¼	—	
330.57	13.05	Chasse	pass	—	3.50	49.68	
336.90	6.33	Vienne	,,	—	3.56	63.30	
—	—	St. Vallier	,,	—	4.19¾	—	
382.39	45.49	Valence	arr.	4.36	4.39	61.80	
—	—	,, ...	dep.	4.39	4.43	—	
409.73	27.34	Montélimar	pass	—	5.11¼	58.02	
442.04	32.31	Orange	,,	—	5.41	64.80	
450.74	8.70	Bédarrides	arr.	—	5.50½	54.90	
—	—	,, ...	dep.	—	5.52	—	
461.06	10.32	Avignon	arr.	5.58	6.5	47.58	
—	—	,, ...	dep.	6.4	6.15	—	
474.11	13.05	Tarascon	pass	—	6.29½	54.00	
482.50	8.39	Arles	,,	—	6.39¾	49.08	
503.0	20.5	Miramas	,,	—	7.3	52.86	
535.93	32.93	Marseille	arr.	7.25	7.41	48.78	

Total booked actual time on journey ... ... 10 hrs. 25 mins.
Total booked running time on journey ... ... 9 ,, 50 ,,
Total actual time on journey ... ... 10 ,, 41 ,,
Total actual running time on journey ... ... 9 ,, 58 ,,

WEATHER—Wet from Blaisy Bas to Marseille.

ENGINES USED—4-6-2 type, 4-cys. compound superheater.

Paris-Laroche ... ... No. 6110.
Laroche-Dijon ... ... No. 6116.
Dijon-Lyon ... ... No. 6148.
Lyon-Avignon ... ... No. 6160.
Avignon-Marseille ... No. 6121.

LOAD—Paris-Dijon, 330 tons.
,, Dijon-Marseille, 286 tons.

CHEMIN DE FER DE P.L.M.

LOG No. 7.

MAY 15TH, 1913.

TRAIN No. 2.—9.0 A.M., MARSEILLE TO PARIS.

Miles from Marseille.	Miles from S. to S.	Station.		Booked Time.	Actual Time.	Point to Point Speed.	Remarks.
—	—	Marseille (St. Charles) ...	dep.	9.0	9.0	—	
6.21	6.21	L'Estaque	pass	—	9.11	33.84	Checked outside and through L'Estaque.
17.07	10.86	Rognac	,,	—	9.27½	39.12	
32.93	15.86	Miramas	,,	—	9.46½	50.04	Checked outside and through Miramas.
53.43	20.50	Arles	,,	—	10.11	52.32	
61.82	8.39	Tarascon	arr.	10.23	10.23	41.82	
—	—	,, ...	dep.	10.29	10.29¾	—	
74.87	13.05	Avignon	arr.	10.51	10.50¼	38.16	Dead slow into Avignon.
—	—	,, ...	dep.	10.57	10.57¼	—	
85.19	10.32	Bédarrides	arr.	—	11.16½	32.16	Bad check and stop 2 min. outside Bédarrides.
—	—	,, ...	dep.	—	11.17½	—	
93.89	8.70	Orange	pass	—	11.31½	37.26	
—	—	Pierrelatte	,,	—	11.53	—	
126.20	32.31	Montélimar	,,	—	12.9½	51.00	
—	—	Livron	,,	—	12.31½	—	
153.54	27.34	Valence	arr.	12.45	12.46½	44.28	
—	—	,, ...	dep.	12.51	12.52¼	—	
—	—	St. Rambert	pass	—	1.31	—	
199.03	45.49	Vienne	,,	—	1.56¼	42.60	
—	—	Feysin	,,	—	2.12½	—	
218.41	19.38	Lyon	arr.	2.22	2.22½	44.28	Long slow into Lyon. 1 min. lost in starting. Long slack and dead slow through Lyon Tunnel, stop for 15 secs.
—	—	,, ...	dep.	2.34	2.39	—	
255.69	37.28	Pontanevaux	pass	—	3.29¾	44.04	
262.53	6.84	Mâcon	arr.	3.33	3.37	56.58	
—	—	,, ...	dep.	3.36	3.40	—	15 secs. lost in starting from Mâcon.
282.41	19.88	Tournus	pass	—	4.3¾	50.22	
293.60	11.19	Varrennes-L.-Grand ...	,,	—	4.16¾	51.60	
298.57	4.97	Chalons S. Sâone ...	,,	—	4.23	47.70	Checked outside Chalons S. Sâone.
308.20	9.63	Chagny	,,	—	4.37¼	40.50	
317.83	9.63	Beaune	,,	—	4.49	49.14	
329.95	12.12	Vougeot	,,	—	5.4¾	49.26	
334.00	4.05	Chambertin	,,	—	5.10	42.24	
340.52	6.52	Dijon	arr.	5.23	5.21¼	40.08	Long slow into Dijon.
—	—	,, ...	dep.	5.35	5.36	—	
345.80	5.28	Vélars	pass	—	5.48½	25.32	
350.14	4.34	Lantenay	,,	—	5.55¾	35.88	
352.32	2.18	Malain	,,	—	6.0½	27.48	
356.90	3.58	Blaisy Bas	,,	—	6.10	22.56	
362.89	5.99	Verrey	,,	—	6.16½	55.26	Two long checks and slow between these stations.
367.54	4.65	Thénissey	,,	—	6.24½	34.86	
371.58	4.04	Darcey	,,	—	6.28½	60.60	
384.95	13.37	Montbard	,,	—	6.42	59.40	
405.14	20.19	Lezinnes	,,	—	7.3½	56.34	
414.15	9.01	Tonnerre	,,	—	7.13	56.88	
434.34	20.19	Briennon	,,	—	7.36	52.62	
439.01	4.67	Laroche	arr.	7.45	7.43¾	36.12	
—	—	,, ...	dep.	7.50	7.51	—	
508.59	69.58	Melun	arr.	—	9.26	43.92	Checked and stopped ½ min. outside Melun.
—	—	,, ...	dep.	—	9.26½	—	
535.93	27.34	Paris	arr.	10.0	10.2	46.14	

Total booked actual time on journey ... ... 13 hrs. 0 mins.
Total booked running time on journey ... ... 12 ,, 10 ,,
Total actual time on journey ... ... 13 ,, 2 ,,
Total actual running time on journey ... ... 11 ,, 52 ,,

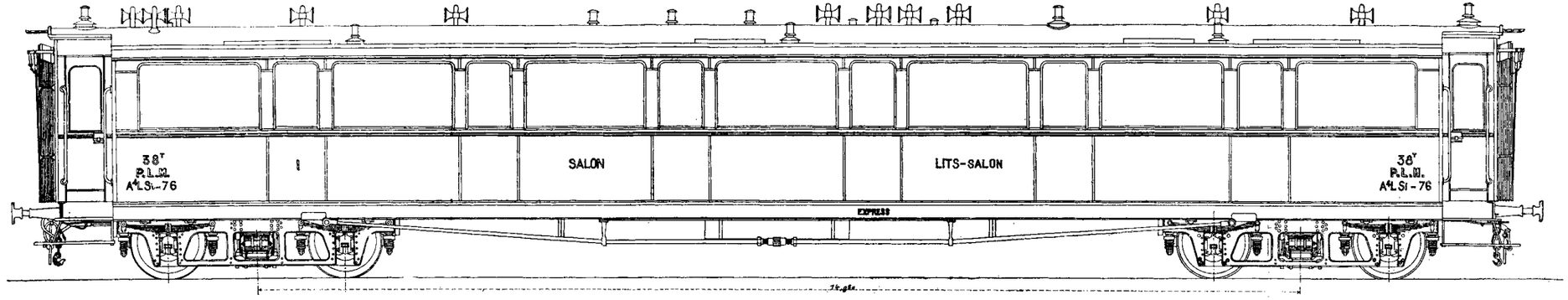
WEATHER—Wet from Marseille to Dijon.

ENGINES USED—4-6-2 type, 4-cys. compound superheater.

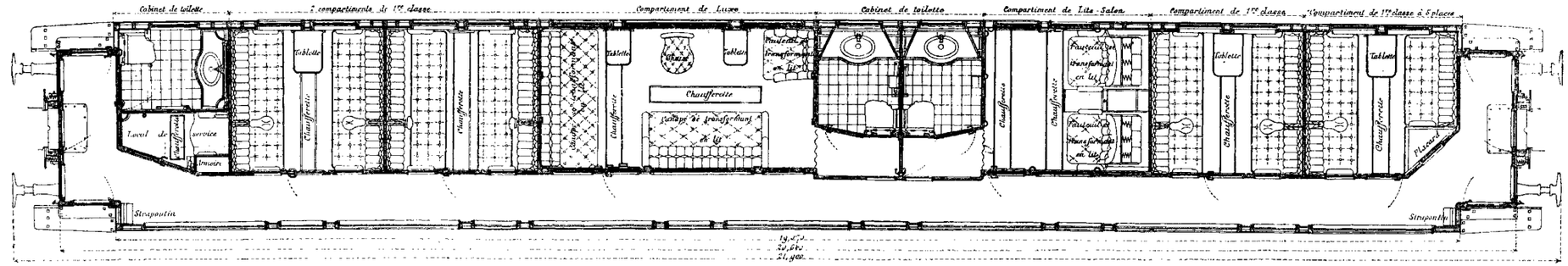
Marseille-Avignon ... No. 6170.
Avignon-Lyon ... ... No. 6164.
Lyon-Dijon ... ... No. 6108.
Dijon-Laroche ... ... No. 6118.

4-6-0 4-cys. compound.
Laroche-Paris ... ... No. 2975.

LOAD—Marseille-Lyon, 291 tons.
,, Lyon-Paris, 330 tons.



Coupe horizontale de la caisse à 1m 50 environ au-dessus du plancher



Chemin de fer P.L.M. 1st Class Carriage Running in "Cote d' Azur Rapide."

TIMINGS AND AVERAGE BOOKED SPEEDS OF BEST PARIS-BORDEAUX TRAINS.

Distance from Paris.	Distance between stations.	Station.	Times of arrival and departure.	Average Speed.	Times of arrival and departure.	Average Speed.	Times of arrival and departure.	Average Speed.	Times of arrival and departure.	Average Speed.
Miles.	Miles.		Train No. 7.	M.P.H.	Train No. 101.	M.P.H.	Train No. 31.	M.P.H.	Train No. 7001.	M.P.H.
		Paris, Quai d'Orsay ...	d. 9.46 a.m.		d. 12.16 p.m.		d. 7.38 p.m.		d. 9.0 p.m.	
3.72	3.72	,, Austerlitz	a. 9.52 ,,	37.2	a. 12.22 ,,	37.2	a. 7.44 ,,	37.2	a. 9.6 ,,	37.2
		,, ,, ...	d. 9.56 ,,		d. 12.26 ,,		d. 7.48 ,,		d. 9.10 ,,	
78.90	75.18	Orleans, Les Aubrais ...	a. 11.22 ,,	52.64	a. 1.47 ,,	55.62	a. 9.29 ,,	44.64	a. 10.42 ,,	49.02
		,, ,, ,, ...	d. 11.26 ,,		d. 1.51 ,,		d. 9.33 ,,		d. 10.46 ,,	
150.76	71.46	Tours, St. Pierre-de-Corps	a. 12.42 p.m.	56.40	a. 3.3 ,,	59.52	a. 10.59 ,,	49.8	a. 12.2 a.m.	56.41
		,, ,, ,, ...	d. 12.48 ,,		d. 3.9 ,,		d. 11.5 ,,		d. 12.8 ,,	
213.12	62.76	Poitiers	a. 2.3 ,,	50.16	a. 4.16 ,,	56.16	a. 12.20 a.m.	50.16	a. 1.18 ,,	53.76
		,, ...	d. 2.8 ,,		d. 4.20 ,,		d. 12.25 ,,		d. 1.23 ,,	
282.72	69.60	Angouleme	a. 3.26 ,,	53.52	a. 5.34 ,,	56.40	a. 1.49 ,,	44.82	a. 2.47 ,,	49.68
		,, ...	d. 3.32 ,,		d. 5.39 ,,		d. 1.54 ,,		d. 2.52 ,,	
366.60	83.88	Bordeaux, St. Jean... ...	a. 5. 7 ,,	52.92	a. 7.9 ,,	55.92	a. 3.43 ,,	46.14	a. 4.27 ,,	52.92
Total time on journey from Paris (D'Orsay)			7 hrs. 11 mins.		6 hrs. 43 mins.		7 hrs. 55 mins.		7 hrs. 17 mins.	
,, running time ,, ,, (Aust.)			6 ,, 46 ,,		6 ,, 24 ,,		7 ,, 35 ,,		6 ,, 57 ,,	
,, average speed ,, ,, ,,			53.58 m.p.h.		56.72 m.p.h.		47.11 m.p.h.		52.35 m.p.h.	

No. 101, "Sud Express de Luxe"
No. 7001, "Pyrénées Cote d'Argent"

TIMINGS AND AVERAGE BOOKED SPEEDS OF BEST BORDEAUX-PARIS TRAINS.

Distance from Bordeaux.	Distance between stations.	Station.	Times of arrival and departure.	Average Speed.	Times of arrival and departure.	Average Speed.	Times of arrival and departure.	Average Speed.
Miles.	Miles.		Train No. 624.	M.P.H.	Train No. 34.	M.P.H.	Train No. 100.	M.P.H.
		Bordeaux, St. Jean ...	d. 1.22 a.m.		d. 11.4 a.m.		d. 2.3 p.m.	
83.88	83.88	Angouleme	a. 3.11 ,,	46.14	a. 12.38 p.m.	53.52	a. 3.33 ,,	55.92
		,, ...	d. 3.16 ,,		d. 12.42 ,,		d. 3.38 ,,	
153.48	69.60	Poitiers	a. 4.45 ,,	46.20	a. 2.1 ,,	52.92	a. 4.53 ,,	55.68
		,, ...	d. 4.51 ,,		d. 2.6 ,,		d. 4.48 ,,	
216.24	62.76	Tours, St. Pierre-de-Corps	a. 6.10 ,,	47.64	a. 3.16 ,,	53.76	a. 6.4 ,,	57.00
		,, ,, ,,	d. 6.17 ,,		d. 3.24 ,,		d. 6.9 ,,	
287 70	71.46	Orleans, Les Aubrais ...	a. 7.43 ,,	49.80	a. 4.40 ,,	56.40	a. 7.22 ,,	58.56
		,, ,, ,,	d. 7.49 ,,		d. 4.45 ,,		d. 7.26 ,,	
362.88	75.18	Paris, Austerlitz	a. 9.27 ,,	46.02	a. 6.7 ,,	54.96	a. 8.45 ,,	57.06
		,, ,, ...	d. 9.31 ,,		d. 6.11 ,,		d. 8.49 ,,	
366.60	3.72	,, Quai d'Orsay ...	a. 9.36 ,,	44.64	a. 6.16 ,,	44.64	a. 8.54 ,,	44.64
Total time on journey to Paris (Austerlitz)...			8 hrs. 5 mins.		7 hrs. 3 mins.		6 hrs. 42 mins.	
,, running time ,, ,, ,,			7 ,, 43 ,,		6 ,, 41 ,,		6 ,, 13 ,,	
,, average speed ,, ,, ,,			47.16 m.p.h.		54.31 m.p.h.		56.84 m.p.h.	

No. 100, "Sud Express de Luxe."
No. 624, "Pyrénées Cote d'Argent."

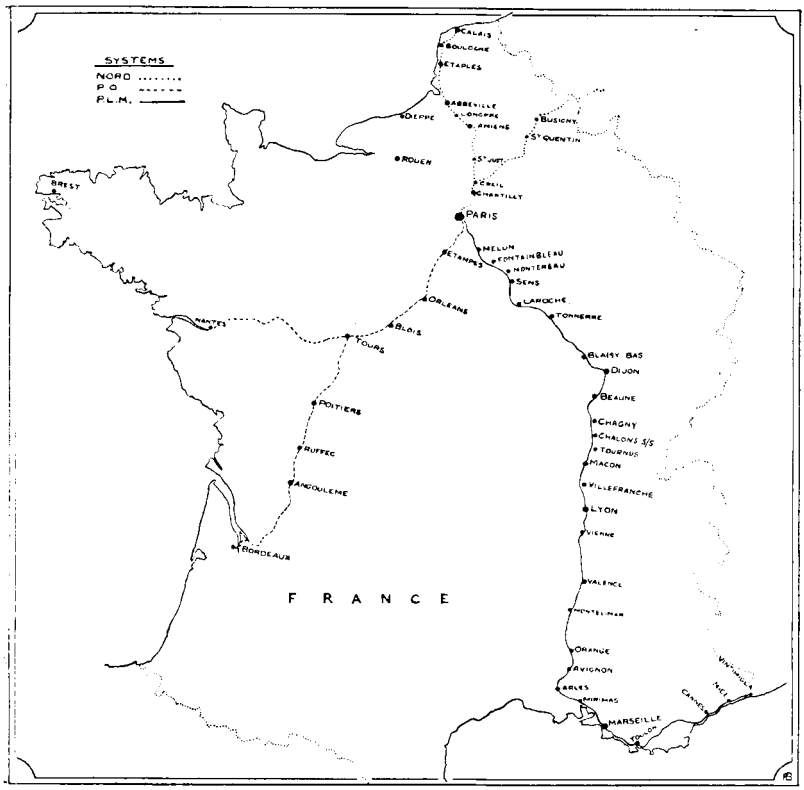
TIMINGS AND AVERAGE BOOKED SPEEDS OF PARIS-MARSEILLE RAPIDES.

Distance from Paris.	Distance between stations	Station.	Times of arrival and departure.	Average Speed.	Times of arrival and departure.	Average Speed.	Times of arrival and departure.	Average Speed.	Times of arrival and departure.	Average Speed.	Times of arrival and departure.	Average Speed.
Miles	Miles		Train No. 15.	M.P.H.	Train No. 1.	M.P.H.	Train No. 17.	M.P.H.	Train No. 21.	M.P.H.	Train No. 7.	M.P.H.
		Paris...	d. 9.0 a.m.		d. 9.15 a.m.		d. 7.45 p.m.		d. 7.55 p.m.		d. 9.0 p.m.	
96.93	96.93	Laroche	a. 10.51 ,,	52.38	a. 11.36 ,,	41.22	a. 9.36 ,,	52.38	a. 9.46 ,,	52.38	a. 11.3 ,,	47.28
		,, ...	d. 10.56 ,,		d. 11.41 ,,		d. 9.41 ,,		d. 9.51 ,,		d. 11.8 ,,	
195.42	98.49	Dijon	a. 12.59 p.m.	48.00	a. 2.9 p.m.	39.90	a. 11.44 ,,	48.00	a. 11.54 ,,	48.00	a. 1.20 ,,	44.76
		,, ...	d. 1.11 ,,		d. 2.19 ,,		d. 11.50 ,,		d. 12.0 mid.		d. 1.26 ,,	
273.40	77.98	Mâcon	a. 2.31 ,,	58.44	a. 3.59 ,,	46.74	a. 1.15 a.m.	55.02	a. 1.25 a.m.	55.02	a. 2.28 ,,	50.82
		... ...	d. 2.34 ,,		d. 4.2 ,,		d. 1.18 ,,		d. 1.28 ,,		d. 3.1 ,,	
317.52	44.12	Lyon (Perrache) ...	a. 3.22 ,,	55.14	a. 5.1 ,,	44.82	a. 2.9 ,,	51.90	a. 2.19 ,,	51.90	a. 3.56 ,,	48.12
		,, ...	d. 3.28 ,,		d. 5.18 ,,		d. 2.15 ,,		d. 2.25 ,,		d. 4.11 ,,	
382.38	64.86	Valence	a. 4.36 ,,	57.18	a. 6.43 ,,	45.78	a. 3.27 ,,	54.00	a. 3.37 ,,	54.00	a. 5.26 ,,	44.70
		,, ...	d. 4.39 ,,		d. 6.50 ,,		d. 3.30 ,,		d. 3.40 ,,		d. 5.29 ,,	
461.05	78.67	Avignon	a. 5.58 ,,	59.70	a. 8.29 ,,	47.64	a. 4.54 ,,	56.16	a. 5.4 ,,	56.16	a. 6.56 ,,	54.24
		,, ...	d. 6.4 ,,		d. 8.38 ,,		d. 5.0 ,,		d. 5.10 ,,		d. 7.10 ,,	
535.93	74.88	Marseille, St. Charles	a. 7.25 ,,	55.44	a. 10.35 ,,	38.34*	a. 6.26 ,,	51.60	a. 6.37 ,,	51.60	a. 8.40 ,,	49.86
Total time on journey from Paris ...			10 hrs. 25 min.		13 hrs. 20 min.		10 hrs. 41 min.		10 hrs. 42 min.		11 hrs. 40 mins.	
,, running time ,, ,, ...			9 ,, 50 ,,		12 ,, 20 ,,		10 ,, 12 ,,		10 ,, 13 ,,		11 ,, 4 ,,	

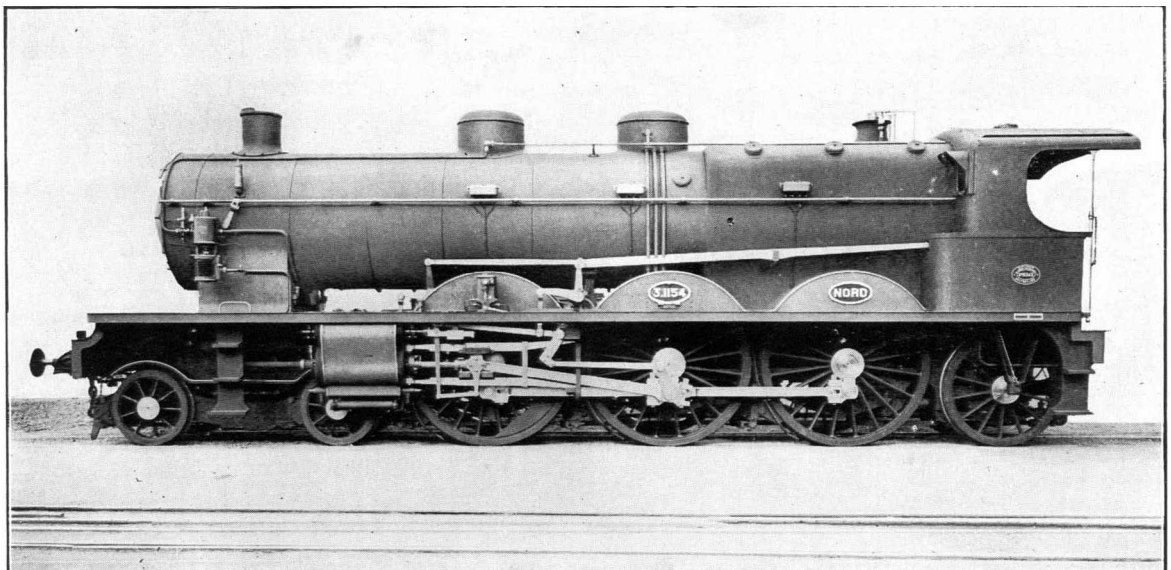
TIMINGS AND AVERAGE BOOKED SPEEDS OF MARSEILLE-PARIS RAPIDES.

Distance from Marseille.	Distance between stations.	Station	Times of arrival and departure.	Average Speed.	Times of arrival and departure.	Average Speed.	Times of arrival and departure.	Average Speed.	Times of arrival and departure.	Average Speed.	Times of arrival and departure.	Average Speed.
Miles	Miles		Train No. 2.	M.P.H.	Train No. 16.	M.P.H.	Train No. 10.	M.P.H.	Train No. 22.	M.P.H.	Train No. 18.	M.P.H.
		Marseille, St. Charles	d. 9.0 a.m.		d. 11.48 a.m.		d. 8.15 p.m.		d. 9.35 p.m.		d. 11.18 p.m.	
74.88	74.88	Avignon	a. 10.51 ,,	40.56*	a. 1.8 p.m.	56.10	a. 9.43 ,,	51.00	a. 11.4 ,,	50.46	a. 12.45 a.m.	51.6
		,,	d. 10.57 ,,		d. 1.14 ,,		d. 9.57 ,,		d. 11.10 ,,		d. 12.51 ,,	
153.54	78.67	Valence	a. 12.45 p.m.	43.68	a. 2.39 ,,	55.50	a. 11.30 ,,	44.10	a. 12.44 a.m.	50.16	a. 2.24 ,,	50.7
		,, ...	d. 12.51 ,,		d. 2.42 ,,		d. 11.33 ,,		d. 12.47 ,,		d. 2.27 ,,	
218.41	64.86	Lyon (Perrache) ...	a. 2.22 ,,	42.72	a. 3.54 ,,	54.00	a. 12.52 a.m.	49.26	a. 2.7 ,,	48.6	a. 3.46 ,,	49.26
		,, ...	d. 2.34 ,,		d. 3.59 ,,		d. 1.7 ,,		d. 2.12 ,,		d. 3.51 ,,	
262.53	44.12	Mâcon...	a. 3.33 ,,	44.82	a. 4.47 ,,	57.54	a. 2.2 ,,	48.12	a. 3.4 ,,	50.88	a. 4.42 ,,	51.9
		,, ...	d. 3.36 ,,		d. 4.50 ,,		d. 2.5 ,,		d. 3.7 ,,		d. 4.45 ,,	
340.52	77.98	Dijon	a. 5.23 ,,	43.68	a. 6.15 ,,	55.02	a. 3.44 ,,	47.22	a. 4.42 ,,	49.20	a. 6.19 ,,	49.74
		,, ...	d. 5.35 ,,		d. 6.27 ,,		d. 3.50 ,,		d. 4.48 ,,		d. 6.25 ,,	
439.01	98.49	Laroche	a. 7.45 ,,	45.42	a. 8.18 ,,	53.22	a. 5.48 ,,	50.04	a. 6.49 ,,	48.84	a. 8.19 ,,	51.78
		,, ...	d. 7.50 ,,		d. 8.25 ,,		d. 5.53 ,,		d. 6.51 ,,		d. 8.24 ,,	
535.93	96.93	Paris	a. 10.0 ,,	44.70	a. 10.15 ,,	52.86	a. 8.0 ,,	45.78	a. 8.50 ,,	48.84	a. 10.30 ,,	46.14
Total time on journey from Marseille			13 hrs. 0 min.		10 hrs. 27 min.		11 hrs. 45 min.		11 hrs. 15 min.		11 hrs. 12 min.	
,, running time ,, ,,			12 ,, 10 ,,		9 ,, 51 ,,		10 ,, 59 ,,		10 ,, 50 ,,		10 ,, 44 ,,	

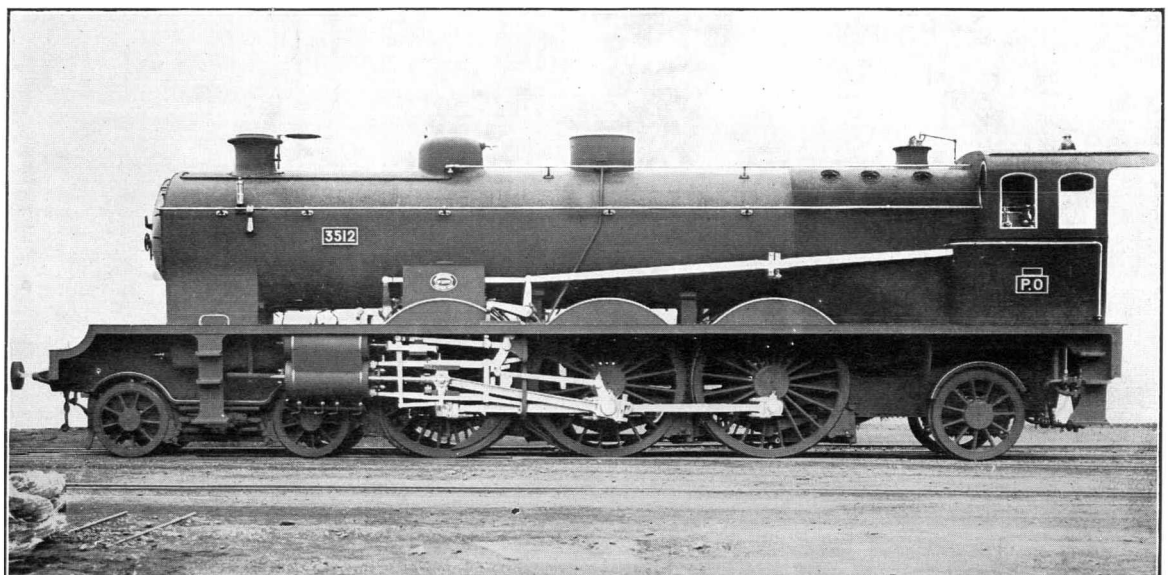
Train No. 2, 1st and 2nd Rapide.
,, ,, 16, Cote D'Azur Rapide (1st Class).
,, ,, 10, Night Rapide (1st Class).
,, ,, 22, Calais-Mediterrannée Express de Luxe.
,, ,, 18, Extra Night Rapide (1st Class).
* Including 6 min. stop at Tarascon, between Marseille and Avignon. Arr., 10.23 a.m. ; dep., 10.29 a.m.



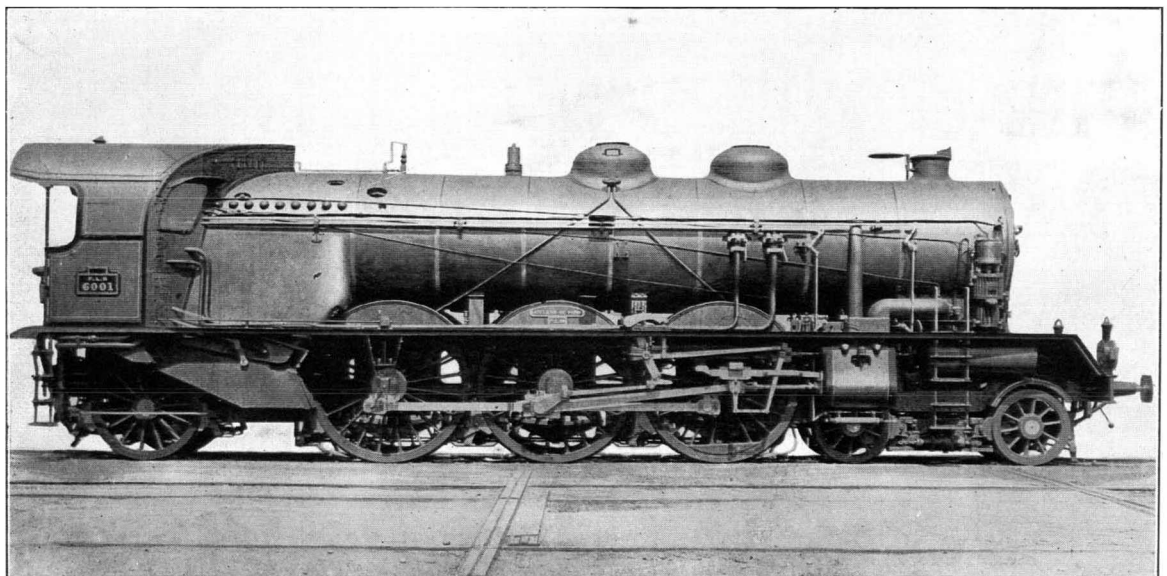
MAP OF FRANCE SHOWING ROUTES MENTIONED.



CHEMIN DE FER DU NORD. PACIFIC TYPE.

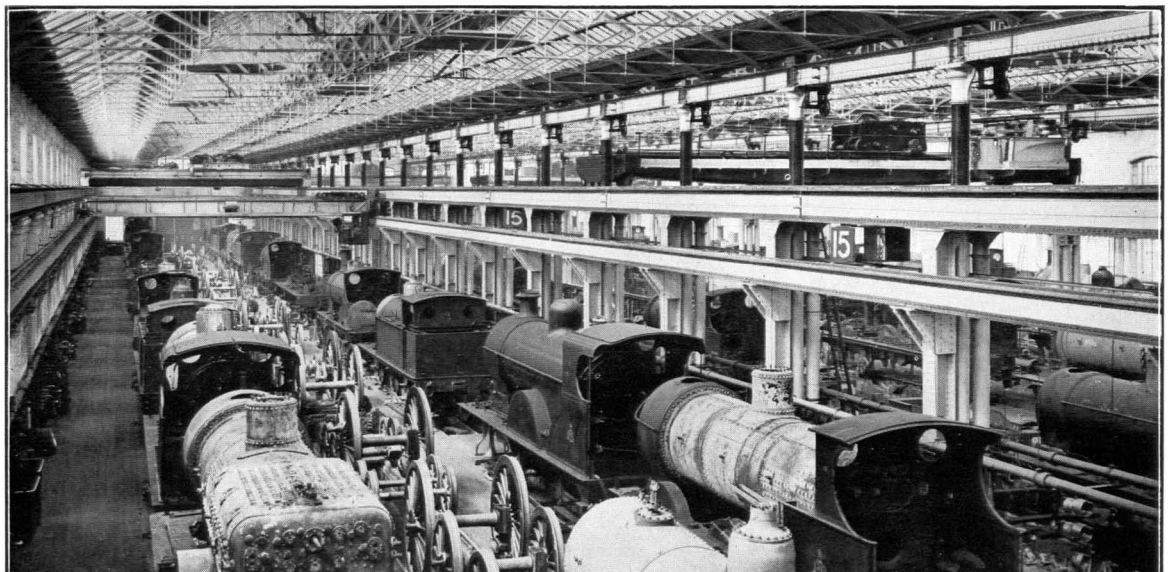


CHEMIN DE FER PARIS A ORLÉANS. PACIFIC TYPE.



Chemin de fer P.L.M. Pacific Type.

The Down "Cote d' Azur Rapide" Leaving Paris.



Erecting Shop, Derby Works, M.R.
Visit to Derby Works, September 10, 1913.